



WARPAINT SERIES No.149

Aero L-39, L-59, L-139 & L-159 Albatros

By Jakub Fojtík Ph.D.

Due to the withdrawal of the type from Czech and Slovak air forces and problems with delivery to Egypt, Tunisia became the sole operator of the L-59 worldwide. A more advanced variant of the L-39 Albatros, designed for the training and light attack roles, Tunisia operated a small fleet of L-59Ts, often used for pilot training and tactical missions. In January 2023, the very last L-59T flight took place, and the type was decommissioned after nearly thirty years of service.



Ethiopian Air Force L-39C.1 from the early operational period in the late 1980s. These aircraft were identical to the Soviet standard.



Czech L-39MS.3 as operated from Píerov airbase. It was the most modern training jet in the Warsaw Pact countries.



The second prototype of the L-159 light combat model. Note the rear cockpit was removed and replaced with a fuel tank and radar radome.



Former Czech Air Force L-159A in the livery of the Iraqi Air Force. This particular aircraft belonged to the first delivered batch and was engaged in combat with *ISIL*.



Former Czech Air Force L-159A after transfer to US company Draken International. This flagship aircraft was the personal plane of Jared Isaacman, later a two-time astronaut aboard the *Crew Dragon* spacecraft.



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DESIGN AND DEVELOPMENT OF JET TRAINERS IN CZECHOSLOVAKIA

Aero, a traditional Czechoslovak aircraft manufacturer, became a licensed producer of the MiG-15UTI in 1950, supplying many Warsaw Pact countries and allies. Over the years, it established a global network for servicing and support. Later, Aero introduced its own jet design - the L-29 Delfin - which is described in detail in Warpaint Series No. 134. The L-29 went on to dominate the jet training market across the Eastern Hemisphere. However, as production of the L-29 Delfin reached full swing, it became increasingly clear that the aircraft could not keep pace with newer jets capable of flying at speeds over

Mach 2 and equipped with advanced onboard sensors. In response, the Czechoslovak Ministry of National Defence issued new tactical and technical requirements for a successor model in 1964.

As the expected original equipment manufacturer (OEM), Aero had direct access to cutting-edge technologies, having built the MiG-19S and MiG-21F-13 under license for the local air force. The L-29 design team evolved into a specialized unit tasked with developing its successor. Due to the specialization of Comecon countries, jet trainers were specifically designated to be designed and produced in Czechoslovakia, with future deliveries planned for the USSR as well. Unlike the competitive selection process that accompanied the L-29, no further

Above: The first flying prototype after careful restoration by LOM PRAHA. Note the all-metal finish with a single red stripe.

competition was anticipated for its successor. Responsibility for developing the new aircraft was assigned to a team led by engineers Jan Vlček and Karel Dlouhý, both of whom had extensive experience with the earlier L-29 design. Initially based at the VZLÚ (Vojenský Zkušební Letecký Ústav – Military Aviation Test Institute), the team later relocated to Aero's new facility.

The technical specifications for the new jet were developed in consultation with Soviet experts. As a result, the aircraft was required to deliver higher thrust and improved flight-handling characteristics. Although the L-29 was easy to fly, it exhibited airflow instability

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Below: Jan Vlček, chief designer of the L-39 Albatros family - one of the most gifted aircraft designers in Czech history.



Right: A scaled-down model of the Mach Trenér supersonic concept - what could have been the L-39. It was never realized.

during certain manoeuvres, occasionally leading to sudden stalls. These edge-case behaviours caused several crashes, typically when the approved flight envelope was exceeded. The new trainer's engine was expected to provide significantly more thrust, enabling shorter take-off runs and allowing high-energy manoeuvres without altitude loss. The airframe was designed to withstand hard landings - common during early training phases - and flight endurance was to be extended to support more circuit flights without refuelling. Additionally, the avionics suite was planned to emulate systems found in the MiG-21 and especially the MiG-23, ensuring a smoother transition for trainee pilots.

In total, two concepts were considered, the first one consisting of two platforms, actually. The first, named L-129, essentially represented a deep modernisation of the L-29 for the elementary and basic stages of training. It was to be followed in the training process by a new model called L-39M-1, with the working name Mach Trenér. The maximum speed of the latter type was slightly above the speed of sound, which was expected to allow practising manoeuvres performed on final fighter types. The cockpit of both aircraft was expected to be identical to ensure easy transition and eliminate transfer gaps when retraining pilots from one model to another. Both aircraft were expected to be supported in training by a set of simulators.

The second concept was built around a single type called L-39. In total, three variants were envisaged - the L-39C training version (C stands for Cvičný - Training), the L-39B light attack version (B stands for Bojový - Combat), and the L-39V target towing derivative (V stands for Vlečný - Towing). After detailed evaluation, the latter concept prevailed as it was more economical, although it was not capable of high-speed flight.

The conceptual study describing all three L-39 sub variants was signed by the chief engineer Jan Vlček on 15th July 1964. It proposed three wing layouts - one with 22° sweep and 8% profile, one with 1° 45' sweep



and 12% profile, and one with 1° 45' sweep and 12% profile with tip tanks for fuel at the ends. The last variant, with a dihedral angle of 2° 30' and trapezoidal wing planform, was selected after a series of wind tunnel tests as the most promising in terms of flight stability. In 1964, a series of wind tunnel tests was launched, focusing on the selection of the optimum layout for ailerons and flaps. The airframe model was also tested in the wind tunnel to verify the final variant's tandem-seating concept with a simple empennage. The wind tunnel tests revealed certain instability around the stabiliser, with severe buffeting at higher speeds. To compensate for this, a set of small aerodynamic cutters was added to the bottom side of the stabiliser.

Aerodynamic testing progressed with downsized models of the definitive shape, and for example, the ideal position for air brakes was determined during this phase. After finalising the wind tunnel testing in Prague, larger models up to 1/6.5 scale were sent to the TsAGI-operated full-size tunnel in Zhukovsky city near Moscow for detailed evaluation. In the development and research work, a significant role was played by the Czechoslovak Military Academy named

after the Czechoslovak president Antonín Zápotocký.

Engineers envisaged using an engine with a minimum thrust of 20kN. The Prague-based company Motorlet proposed a concept for a new turbofan engine with 21.6kN thrust, but it was still in the early conceptual development stage. Should the development go wrong (as it initially did with the L-29), it could jeopardise the entire aircraft project, and Motorlet was unable to provide guarantees for reaching the development milestones. After evaluating all remaining available options, the Soviet AI-25 turbofan - originally designed for the Yak-40 commuter aircraft - was selected. The engine, originally purely civilian, required extensive post-development modifications to withstand the aerobatic operations of the new jet trainer. First, the tip clearances of the compressor stages were increased to eliminate the risk of collision with the engine casing during shaft bending induced by high-g manoeuvres. The oil system also had to be modified to ensure continuous lubrication during zero-g and inverted flight conditions - situations unimaginable in the Yak-40!

Starting the engine also proved problematic. In the Yak-40, an AI-9 APU - a unit typically found on Mi-8MT/Mi-17 and Mi-24 helicopters - is used. While effective, it is bulky and heavy, making it unsuitable for the compact airframe of the jet trainer. A new starter solution had to be found. The new engine variant, named AI-25W, was expected to be developed by Motorlet. Curiously, the letter 'W' stands for Walter, the pre-communist era name of the Motorlet company, which was banned after 1948, as companies - except for a few examples such as Škoda - were not allowed to bear names linked to their 'capitalist' founders. Although censors were normally vigilant, they overlooked this small nod to the democratic era.

The estimated thrust of the AI-25W was



Left: The initial wooden and plywood L-39 mock-up used for fit checks. It closely resembles the early prototypes. Note the R-3 missile launch rail under the wing.

Right: Various test beds were used for the L-39's systems. Pictured here is a MiG-15 equipped with a tubular frame for landing gear testing.

set at 14.42kN, which applied only to the initial series, with an expected increase in performance later. The first test engines were converted from Soviet-made AI-25 units. Motorlet redesigned these engines and equipped them with a new oil system and a dynamo starter from the MiG-19, eliminating the need for the AI-9 APU. At the turn of the year 1967, the prototype engines were thoroughly tested on a ground rig and later installed on the Il-28 flying laboratory operated by VZLÚ. The test engine was mounted in the tail area of the Ilyushin, where the rear gunner would normally be stationed.

As development progressed, various design features were evaluated. Maintenance accessibility was a key requirement, leading to a removable tail section and an initially proposed foldable nose. The tail design was approved and later proved highly effective - allowing engine swaps in under thirty minutes during Soviet trials. Scaled-down plywood models were used to verify these concepts. The foldable nose was eventually replaced by large, openable side panels for better access to avionics, due to structural stiffness concerns. In February 1967, a full-scale mock-up was presented to the Czechoslovak Ministry of National Defence, the Air Force, the Soviet Air Force, and several Soviet research organizations. It was approved with only minor revisions - the



aircraft had finally taken shape.

Another major milestone was the development of a domestic ejection seat. Due to cockpit size and weight constraints, existing Soviet seats were unsuitable. None of the Soviet manufacturers, including the future NPP Zvezda, offered support. As a result, the VS-1 (Vystřelovací Sedadlo – Ejection Seat) was developed by a VZLÚ team led by Jiří Matějček. This made Czechoslovakia the

sixth country in the world - after the UK, USA, USSR, pre-WWII Germany, and Sweden - to develop its own ejection seat.

The VS-1 was completed in 1967, and nearly fifty test ejections were conducted over the following years, primarily from a MiG-15UTI testbed with the seat installed in the rear cockpit. These tests were performed without the rocket booster. The final seat was remarkably lightweight, weighing under 80kg even when fully equipped with parachutes, a rocket motor, and an emergency kit. In 1967, production of the initial test series of aircraft began. Aero Vodochody was designated as the final assembler and producer of the fuselage, with subassemblies supplied by Rudý Letov of Prague (tail section) and Let of Kunovice (wings). The first prototype airframe, designated X-01, was completed in spring 1968. It lacked onboard equipment, as it was intended for a two-year static test campaign at VZLÚ.



Left: The very first flying L-39 prototype, registered OK-32. Note the small engine intakes and the extended wing root leading edge - both features were later removed.

Below: The same aircraft in a rare full-colour image in front of the Aero production halls, still featuring the small engine intakes.



Right: The same prototype as the previous page during a later testing phase, now registered as OK-180 and fitted with enlarged engine intakes.

Meanwhile, construction of the first flying prototype, X-02, was underway. The bare airframe was completed in January 1968, but full integration of components took another six months. Some parts, such as the engine inlets, were still under development and tested separately - both in flight aboard an Il-28 flying laboratory and on ground rigs at Motorlet. Temporary weight substitutes were used in place of missing components, allowing the airframe to undergo ground resonance testing using the French-made Prodera system.

By August, the aircraft was fully equipped and began engine inlet distortion tests, which led to several design changes in the inlet area. Following additional evaluations, the aircraft was cleared for its first flight in a report signed on 25th October 1968. The report included specific flight restrictions and outlined expected aircraft behaviour under various conditions, all based on theoretical calculations and ground tests. For example, it recommended careful monitoring of rudder effectiveness with the nose gear retracted and engine performance during turns, given the side-mounted intakes. The g-limit was set at +6/-2g.

Before flight testing, a comprehensive pre-flight sequence was conducted to verify the functionality of all control surfaces and systems, including hydraulics, fuel, oxygen, fire suppression, and cockpit pressurization. The aircraft was not yet equipped with a live ejection seat, so only the emergency canopy release was tested. Final pre-flight checks included engine runs to assess performance, vibration levels, and electrical insulation resistance. After passing all tests, the aircraft was weighed and its moments of inertia calculated.

On 28th October 1968 - coinciding with the 50th anniversary of Czechoslovak independence, though overshadowed by the recent Warsaw Pact invasion - the X-02

Below: Final paint scheme of the first prototype, bearing the fuselage code 3902 - indicating the second L-39 airframe (the first was used for ground tests only). The aircraft is connected to the KL-39 debriefing system housed in a UAZ 452 van.



prototype, bearing test registration OK-32, began taxi trials at Vodochody Airport at 14.54. Test pilot Rudolf Duchoň performed three high-speed runs up to the take-off speed of 175 km/h to evaluate braking and directional control.

A few days later, on 4th November at 9.15, Duchoň conducted the aircraft's maiden flight, lasting thirty-five minutes. Flight guidelines limited the speed to 375km/h. The pilot climbed to 1,000 meters under the cloud base and tested the aircraft across a speed range from 160km/h (with full flaps) to 360km/h. During take-off, the trim system malfunctioned and directional stability issues were noted, but overall the aircraft performed exceptionally well.

After landing, a small celebration was held at Aero's management offices, including a ceremonial christening of the aircraft with champagne by Jan Krejčí, the Czechoslovak Minister of Heavy Industry. The event featured a flight demonstration by four L-29s from the Košice-based Air Force Academy, followed by solo aerobatics from the L-29A Akrobat, piloted by test pilot Juraj Šouc. The program concluded with a second flight of the X-02, again piloted by Duchoň, who performed a low-speed pass and an unplanned barrel roll. He later praised the aircraft's handling characteristics as superior to the L-29.

Throughout November, further tests focused on handling qualities. These led to modifications of the aileron and rudder

control rods to improve stability margins. Engine inlet distortion tests revealed a tendency for the engine to surge. Despite this, the aircraft was demonstrated to the State Military Committee on 2nd December. During landing, after a twelve-minute display, a main landing gear tire burst due to overheating from heavy braking. The pilot managed to stop the aircraft safely without veering off the runway. The aircraft was quickly repaired, and subsequent grass-strip take-offs were conducted at Letňany Airport near VZLÚ. These tests confirmed the aircraft's ability to operate from unpaved surfaces - a key requirement of the Soviet Air Force. The elevated engine intakes above the wing effectively prevented debris ingestion.

In early 1969, inverted flight tests were conducted to assess aerodynamic stability and engine performance under sustained negative-g conditions. As a result, designers removed the wing root fairings and replaced them with smaller versions to reduce airflow disruption to the engine intakes during high-angle-of-attack manoeuvres. The engine was also replaced after surging during one flight.

With the new engine installed, the prototype flew again on 14th March. However, five days later, the engine stalled during spin tests. The pilot attempted three restarts, all unsuccessful. An emergency landing was executed on a grass strip using backup systems for flap and undercarriage retraction. The aircraft landed safely and undamaged, validating emergency





procedures. Total flight time at that point was 10 hours and 51 minutes. The investigation lasted several months, and the next flight did not occur until 15th May 1969. The following day, chief engineer Jan Vlček flew as a passenger with Duchoň for the first time. In the ensuing months, engineers modified the engine inlets. The original splitter plates proved ineffective and were removed. Internal splitter walls were extended to mix airflow from both sides over a longer path, and diverter plates were enlarged. However, these changes failed to resolve the instability.

After extensive testing with scale models, the inlets were extended by 370mm. Between

February and April 1970, the prototype was modified accordingly, and the issue was finally resolved. By then, engineers were already considering a more powerful engine, as the aircraft's increasing weight meant it no longer met some tactical requirements set by the Ministry of National Defence - particularly in terms of flight range and landing roll. Meanwhile, the X-01 prototype completed its static testing campaign in mid-1970.

The second flying prototype, X-03, made its maiden flight on 4th May 1969 at the Aero Vodochody factory airfield, piloted by Rudolf Duchoň. Like the X-02, it initially featured air



Above left: Front cockpit detail of the first flying prototype. It lacked some of the instruments added later but was close to the serial configuration.

Above right: Rear cockpit of the first flying prototype after restoration. The ejection seats were painted orange for visibility.

intakes with small splitter plates and auxiliary bypass flow windows on the sides. However, it was equipped from the outset with smaller aerodynamic fairings at the wing roots. Despite these refinements, the aircraft remained prone to engine surge. Due to pressure to accelerate testing, it was nonetheless transferred to VZLÚ for company trials. Registered as OK-182, the aircraft's designation followed the international Czechoslovak aircraft code, with numbering linked to VZLÚ's R&D registry rather than the civilian register. The X-03 played a key role in testing and refining systems such as air conditioning, hydraulics, and pilot flight gear. It later underwent stall and stall warning evaluations, which revealed minimal warning signs and a high likelihood of delayed pilot awareness during stall onset. To address this, engineers added small, 150mm triangular bars to the leading edge of the wing roots near the fuselage. These elements induced subtle control stick vibrations as the aircraft approached stall conditions - a natural and intuitive cue for trainee pilots.

Subsequent flight-testing focused on calibration and verification of longitudinal and lateral responses within the flight



Left: Likely the very first L-39 prototype - though unconfirmed at the Prague-based Military Air Force Research Institute's static test rig.

Right: A VS-1 seat ejection test from the second flying prototype, using a dummy pilot. Note the wire mesh protecting the engine intakes and the calibration chessboard markings.

envelope. These tests directly contributed to the development of control logic and artificial response algorithms for the TL-39 full-flight simulator, developed in parallel by Rudý Letov. The X-03 accumulated 94 hours of flight time during testing, with additional hours logged during military demonstrations. Upon reaching 100 flight hours, the aircraft underwent a major overhaul to inspect for structural issues. It then rejoined the test program, this time focusing on verification of the VS-1 ejection seat. Engineers installed extensive measurement equipment and protected the air intakes with wire mesh. The aircraft was painted with black-and-white aiming circles and checkerboard patterns to aid in high-speed film analysis. Numerous canopy jettison tests were conducted at various speeds and altitudes. While the canopy could be manually opened, the automatic ejection sequence used four pyrotechnic cartridge-powered telescopic rods mounted in the fuselage sides. The first live ejection of a dummy - nicknamed Oskar - occurred on 6th November 1970. The promising results led to the development of the VS-1BRI variant with minor improvements.

Live tests followed in August 1971, with military paratrooper Petr Suchomel safely ejecting at 2,000m altitude and 370km/h on 10th August. A few days later, Karel Plzák performed a similar test. The VS-1BRI seat was a sophisticated system featuring an ejection gun that guided the seat along a rail above the cockpit, with the rocket motor igniting at the end of the trajectory. The theoretical minimum ejection altitude was zero, and only seventy meters for inverted flight - though forward speed was required to ensure canopy clearance. The seat's headrest was designed to cut through canopy transparencies in case of jettison failure, theoretically enabling zero-zero ejection, although this was not officially approved. The

Below: Second flying L-39 prototype, registered OK-23, connected to a ground electrical cart behind it. It still features the small engine intakes.



system included automatic pyrotechnic leg restraints and a fully automated sequence using metal cables and timed triggers.

In late July 1972, further ejection tests were conducted at 1,500m and 350km/h. These confirmed minimal health impact on the pilot, allowing continued flight service post-ejection. For inverted flight-testing, the seat was evaluated using a sliding rig mounted on the experimental HC-3A helicopter operated by VZLÚ.

In June 1972, the X-03 entered military trials. Its first task was to verify the trajectory of the jettisoned canopy using improved locks and repositioned ejection telescopes. These modifications were validated through twenty-eight canopy ejections. Over the full test period, the seat underwent sixty ground rig ejections, 115 MiG-15UTI ejections, and forty-seven L-39 ejections, all meeting operational requirements. In December 1971, the X-03 also participated in landing gear tests. The nose gear exhibited shimmy despite

a dedicated damper. For testing, small rocket engines with side-facing nozzles were strapped to the nose gear to induce shimmy during high-speed taxiing. The issue was traced to a flawed tire design, which was corrected by adding a central rail along the axis of symmetry.

The aircraft also underwent icing condition tests to verify full controllability. After consultation with the Soviet TsAGI aerodynamic institute, special slats were installed to simulate limited control surface movement. Flight tests confirmed sufficient controllability. Following these trials, the X-03 was grounded and repurposed for non-flying tests, including integration of the GSh-23 23mm twin-barrel cannon for the future L-39ZA variant.

The next prototype, X-05, made its first flight on 23rd September 1969, again piloted by Rudolf Duchoň. It featured five bypass air inlets on each side of the engine intakes but lacked splitter plates. During eight test flights





Above: Group flight of the first (rear) and third (front) L-39 flying prototypes. No two prototypes shared the same paint scheme.

production aircraft were initially certified for only 1,800 flight hours. This limit was extended to 2,400 hours in 1974, 3,000 hours in 1977, and finally 3,600 hours in 1981. Some aircraft originally rated for 3,000 hours were later recalculated and certified for 3,600.

Early production batches (until 1977) were typically assigned a ten-year service life, later extended to the standard fifteen years. This calendar limit reflected Eastern Bloc maintenance philosophy, which aimed to prevent significant corrosion within that timeframe. General overhauls were typically performed after seven and a half years or 1,000–1,200 flight hours, whichever came first, restoring the aircraft to factory condition. These overhauls also kept logistics and maintenance facilities active during peacetime, preserving infrastructure and personnel readiness. In wartime, calendar limits would be lifted, and overhaul plants would shift to repairing battle damage and expired aircraft. After thousands of operational hours, structural reinforcements were added to critical areas - particularly the cockpit-to-midsection junction and wing attachment points. Aircraft with these upgrades were certified for up to 4,500 flight hours. Over time, service life limits continued to increase, and some L-39s have remained in service for over forty years, undergoing multiple overhauls.

On 28th April 1970, the X-06 prototype made its maiden flight at Vodochody Airport. It was the first aircraft to feature extended engine intakes from the outset. A new engine

Left: Instrument panel of the third flying prototype. As it wasn't used for weapons training, it lacked the ASP-3 gunsight. Note the early-style ejection handle.



focused on engine surge under high g-loads, the bypass inlets were covered, and results showed no improvement in engine behaviour. Consequently, the bypass inlets were removed, and the engine intakes were modified with longer internal splitters to merge airflow from both sides within the fuselage. In this configuration, the aircraft resumed test flights in April 1970. By May, it entered the second stage of company testing, focusing on flight envelope limits, aerobatic capabilities, and controllability with underwing loads during spins and high-angle-of-attack manoeuvres. During one flight, the pilot exceeded the g-limit, reaching +10.2g, which deformed the wing skin and necessitated full wing replacement.

At the end of summer 1970, the X-05 was flown to Poprad Airport in Slovakia for external load testing. In October, it underwent

spin characteristic evaluations, completing seventy-eight spin tests. The aircraft was equipped with a stabilization keel, which proved ineffective and was later removed. In February 1971, the X-05 was transferred to Prague's Kbely Airport, where it was taken over by VZS 031 (Vojenské Zkušební Středisko – Military Test Centre). By 6th July, the aircraft had completed ninety-two measurement flights. In total, it logged 159 flights, during which two AI-25W engines were damaged due to in-flight surges.

In 1970, the X-04 prototype, originally scheduled for completion before the X-05, entered service life testing to verify the practical feasibility of a 3,000-flight-hour lifespan. This figure was based on operational load spectrum calculations for the L-39 in its military training role. Due to the time-intensive nature of these tests, early

Right: The third flying prototype configured for testing a Czech-made gun pod with three machine guns. Note the additional Pitot tube on the nose.

starting system was introduced, replacing the provisional MiG-19 dynamo starter with a modern air starter that combined auxiliary power unit (APU) functionality. After considering a domestic APU development, Aero opted to license an existing design. The Czechoslovak company PBS Velká Bíteš collaborated with French manufacturer Microturbo to locally produce the Saphir 4-2 APU, originally designed for the Dassault Mystère 20 business jet. Renamed Safir in Czechoslovakia, the unit was slightly modified to fit the L-39.

During extended company testing, the X-06 experienced an emergency: the port landing gear failed to deploy and lock properly. Pilot Vlastimil David chose to retract the starboard gear and nose wheel and perform a belly landing on the grass strip at Vodochody. The manoeuvre was successful, causing only minor damage to belly-mounted antennas. The aircraft was quickly repaired and resumed testing, including calibration of the new RV-05 radio altimeter.

The X-07 prototype was test-flown by Juraj Šouc on 15th December 1970. It incorporated nearly all modifications derived from earlier prototypes, including redesigned wing roots, engine intakes, vertical stabilizer, and control systems. The aircraft was handed over to military representatives in February 1971 and participated in ninety-two measurement and verification flights



conducted by VZS 031 (Military Test Centre).

Later tests focused on engine performance. The AI-25W engine failed to meet thrust expectations, prompting the Soviet Ukraine-based Progress company to propose an improved model, the AI-25TL. This engine was eventually installed in the X-02 and X-07 prototypes. Under ministerial directive, Motorlet transferred all AI-25W documentation to Progress to aid in the AI-25TL's development. Both re-engined prototypes began flight-testing in spring 1972. Due to the similarity between the two engine models, tests concluded with a recommendation to adopt the AI-25TL across the fleet. However, the new engine's higher bleed air temperature and pressure required significant modifications to the aircraft's

ventilation and air systems. A Snecma turbocooler, sourced from France, was installed and tested on the X-02, X-03, and X-05 prototypes. The unit was later licensed for production by PBS.

Only after installation of the AI-25TL did the L-39 meet its tactical and technical performance requirements. In 1973, the X-06 also received the AI-25TL and was used primarily to calibrate a ground testing system known as KL-39. Housed in a van, KL-39 connected to the aircraft via cables and automatically recorded dozens of maintenance parameters, streamlining servicing procedures.

Beginning in June 1973, the X-06 participated in live-fire tests with S-5 unguided rockets and FAB-50/FAB-100 bombs. These tests helped calibrate the gunsight and define flight envelope limits for weapon deployment. Scenarios involving partial or failed store separation were also evaluated. Weapons were aimed using the ASP-3NM/U-39Z collimator optical gunsight, which displayed a circular impact zone based on selected range. The electrical firing system for UB-16-57 rocket pods allowed salvo firing with a 0.025-second delay between port and starboard pods, and a 0.5-second delay between individual rockets. While the ASP gunsight supported S-5 rockets up to 2 km, optimal accuracy was achieved at shorter ranges.

In parallel with engine and flight-testing, onboard systems underwent significant development. The original RTL-11 VHF radio was replaced by the lighter RTL-31 on the X-03, but its performance was unsatisfactory. Instead, the heavier Soviet-made R-832M radio was selected, requiring a redesign of the avionics bay. Externally, this change was visible via a smaller dielectric fairing atop the vertical stabilizer, housing a compact antenna. The X-05 helped determine the optimal location for the Pitot-static tube in undisturbed airflow. While prototypes used a nose boom, the final location was on the wing, mounted on a long tube-type boom. This setup provided precise pressure readings but posed operational challenges, as ground crews frequently bumped into the booms. Over time,



Above left: The fourth flying prototype during landing. It was the first aircraft built with the final engine inlet design from the outset.

Left: The fourth flying prototype during wet-soil landing tests. Thanks to the engine inlets above the wing, sprayed dirt didn't affect the engine.

Right: Fifth flying prototype with a non-standard nose cone. The nose bears an emblem commemorating 500 fleet flight hours, achieved by this aircraft.

crews adapted, and the booms became informal storage spots for ear protection - a common sight on parked L-39s. The X-06 also underwent extensive unpaved surface operation tests, flying from dusty and muddy airstrips. The elevated engine intakes above the wing effectively prevented debris ingestion, eliminating the need for a nose wheel mudguard - unlike Soviet jets.

The X-06 and X-07 prototypes also passed integration tests with the new RV-5 radio altimeter, replacing the older RV-UM type with its characteristic 'II'-shaped antennas. The X-07 prototype additionally participated in the integration of the Kvant radar rangefinder - a simplified radar-based ranging system designed to practise aerial target interception independently of weather conditions.

The Kvant system was intended for training with R-3U captive missiles and even R-3S live missiles when fired at aerial towed targets. The R-3 missile, a reverse-engineered copy of the American Sidewinder, could be guided by the Kvant system at altitudes between 2,500 and 6,000 metres, or use its infrared seeker between 1,000 and 6,000 metres. However, the target's speed had to be between 350 and 550km/h, and the speed differential between interceptor and target could not exceed 100 km/h. The effective range was 1,200 to 3,000 metres for Kvant-guided interception and 1,200 to 2,000 metres for IR-guided interception.

Even when the Kvant system successfully located the target, missile launch angles were limited to a 20° offset from the sun. Additionally, reflections from bodies of water could confuse the seeker. Ultimately, the Kvant system served primarily to familiarise pilots with radar interception fundamentals. Due to its limited effectiveness - particularly

Below: Landing of the first flying prototype on a highway. The road was closed in one direction, allowing vehicles to pass by. This image was taken during testing.



its short range - it was not widely adopted. A total of five R-3S missiles were fired during a test campaign aimed at evaluating the potential impact of rocket smoke trails on engine surges. Although mounted on hardpoints relatively distant from the engine, the missile's smoke could cross the aircraft's path and be ingested by the engine during interception. The X-07 prototype also served as a testbed for the RSBN-5S Iskra (Spark) short-range navigation system. In this configuration, with all enhancements fully integrated, the X-07 joined Soviet Air Force acceptance trials. It featured an all-metal finish, bore the tactical code '07', and displayed the red star insignia. These tests, conducted at several airfields across the USSR, were supported by Aero maintenance teams. Mechanics demonstrated procedures such as accelerated engine replacement under field conditions, successfully completing the task in under thirty minutes with an experienced crew. The Soviets also independently evaluated the aircraft's flight characteristics, tested operations from unpaved airstrips, and assessed maintenance procedures. The Soviet Air Force's military committee recommended the L-39 for service, although the final report noted that some performance parameters - such as range,

landing speed, and landing roll - were not met. These deviations were deemed acceptable, as they were largely due to increased weight from additional customer requirements.

In 1971, a batch of five initial L-39s - known as the 'zero series' - was completed, with the first aircraft flown on 7th September 1970. All were designated L-39C. Although completed earlier, they were formally delivered to the military administration in March 1972, pending the arrival of AI-25TL engines (initially fitted with AI-25W engines). Aircraft 0001, 0002, and 0005 were assigned to the VZS 031 test centre at Prague-Kbely, while 0003 and 0004 were transferred to the Military Aviation College at Košice Airbase in what is now eastern Slovakia. Aircraft 0001 and 0005 were later relocated to Košice as well.

The initial instructor cadre developed flight manuals, documentation, and training syllabuses. The Kbely fleet participated in flight envelope testing, including flutter tests induced by rocket engines with 1.98kN thrust, developed by the local military academy. In-flight data were collected using measurement equipment housed in protruding pods mounted in place of wingtip tanks.

Aircraft 0004 was publicly displayed for the first time at the International Machinery





Above: The fourth pre-serial aircraft displayed at the International Machinery Fair in Brno, 1973. This paint scheme was used on several early models.

Fair in Brno in 1973, attracting significant attention. Aero had to determine how to deliver the aircraft to the exhibition site, as disassembly was impractical due to time constraints and ongoing flight tests. Neither of Brno's military-operated airports could accommodate towing the aircraft to the venue due to infrastructure limitations, nor was there a suitable grass strip for landing. Instead, the aircraft landed on the nearby D1 motorway connecting Prague and Brno. Piloted by Juraj Šouc, it touched down on 1st March 1973 on the Prague-bound carriageway, while traffic continued uninterrupted on the opposite side - a spectacular sight for passing motorists. The landing had been rehearsed on another under-construction motorway using the first flying prototype.

Production of the initial series began in 1970 with subassembly manufacturing. Final assembly commenced in 1972, and the first true serial-configuration L-39s were flown in March 1973. Full-scale production of the L-39C variant began in 1973, with approximately 2,294 units built. The last aircraft were completed in 1991, with later deliveries drawn from stock not accepted by

the collapsing USSR. Notably, the production standard remained largely unchanged over two decades.

Most aircraft conformed to the L-39C.1 standard, accepted by both Czechoslovakia and the USSR. These jets were equipped with RTL-11 radios and Kvant rangefinders (used by the Soviet Air Force only up to the 11th production series, after which RTL-11 was replaced by the R-832M radio and the Kvant system was omitted). The L-39C.1 variant was also delivered to Algeria, Cuba, Ethiopia, and Vietnam. Iraq operated the L-39C.2 variant, which lacked the RSBN-5S SHORAN system, while Afghanistan primarily used the L-39C.4 with simplified avionics and a modified ejection seat survival kit. Vietnam operated the L-39C.11 variant, which included the RSBN-5S SHORAN system but lacked direct integration with the control system.

Aircraft originally ordered by the Soviet Air Force were redirected to Algeria, Ethiopia, Cuba, and Vietnam with Moscow's approval. In the record year of 1988, 254 jets were completed - one new aircraft every working day.

Since 2006, the manufacturer has operated one L-39C.1 aircraft (fuselage number 2626), designated L-39CA, equipped with modernised avionics including the HUD-39 head-up display from Czech company SPEEL Praha.

Total production of all L-39 variants reached 2,897 aircraft, including armed versions. Of these, approximately 2,889 were delivered to military operators, with the remainder sold to private US owners during the turbulent 1990s, when the manufacturer sought alternative revenue streams. Many L-39C deliveries in the 1990s - to Algeria, Ethiopia, and Yemen - consisted of aircraft originally built for the USSR but never accepted. Some were shipped directly from Aero to the USA, where they were designated L-39CT. However, this was not a distinct variant but rather aircraft with removed equipment deemed unnecessary by American owners, such as the RSBN navigation system. The L-39CT designation was primarily used in documentation for differentiation purposes.

Alongside jet production, a comprehensive system of training aids was developed and brought into manufacture. For ground training, hundreds of cutaway diagrams and even real cutaway components mounted on tables were produced. Training and flight documentation was prepared in Czech, Russian, French, German, and English, depending on the preferences of the end user. In collaboration with the Rudý Letov company, approximately 113 full-mission TL-39 simulators were produced between 1973 and 1990. One modernised TL-39M unit was shipped to the USSR for testing shortly before 1991, but it never



Left: Although wearing the OK-002 test registration, this aircraft is not a prototype but a testbed used by the Military Aviation Test Institute.



Above: Final assembly line at the Aero Vodochody facility north of Prague. At peak production, the factory rolled out a brand-new jet every working day!

entered serial production.

In addition to flight simulators, NKTL-39-21 ejection simulators were also developed. These were simplified cockpit mock-ups equipped with an ejection seat and authentic seat controls. Trainees used the simulator to practise emergency procedures such as seat adjustment, canopy emergency release, and seat ejection. The final task was particularly dramatic, as the simulator could launch the training seat along a rail to several

metres in altitude. Powered by a pyrotechnic cartridge, the simulator reportedly produced sound, flame, and smoke effects comparable to a real ejection. Around forty NKTL simulators were manufactured.

Rudý Letov also produced several KL-39 test and evaluation vehicles, built on the chassis of the UAZ 452 van. When connected to an L-39 via cable, the vehicle could monitor approximately 237 parameters of the jet. It facilitated centralised maintenance

reporting and enabled system testing directly from the van. The system automatically graded parameters on a scale from 0 (compliant), to 1 (below threshold), to 2 (above threshold). The KL-39 vehicle system was designed to minimise turnaround time for the jet during training operations.

Below: Instructor station of the TL-39 simulator, with the training cabin behind. Note the white-sprayed canopy sections that reduce the student's field of view.

Right: NKTL-39-59 ejection training system. It used a reduced pyrotechnic charge, giving trainees a realistic ejection experience.





FAMILY EXPANSION - OTHER VARIANTS

During the conceptual development of the L-39, several specialised variants were anticipated for future production. Among the first discussed was the L-39B (Bitevní, meaning 'combat') variant, featuring a single-seat cockpit. The rear cockpit area was intended to be replaced with ammunition storage and the installation of two NR-23 cannons of 23mm calibre in the lower fuselage. Optionally, locally manufactured 7.62 mm machine guns were considered for installation in the nose tip.

Four underwing hardpoints were designed to carry UB-16-57UMVP unguided rocket launchers, free-fall bombs of up to 250 kg, 122mm calibre unguided munitions, or two R-3S infrared-guided missiles. For ground attack missions, integration of two S-24 240mm unguided rockets was also planned. In total, the aircraft was expected to carry up to 1,500 kg of weaponry. This variant, sometimes referred to as the A-139 Jestřáb (Hawk), attracted interest from the Soviet Air Force, although many of its systems - such as missile guidance - were still under

development. The front cockpit was to be armoured against 12.7mm rounds, and a rocket booster similar to JATO (Jet-Assisted Take-Off) was proposed to shorten the take-off roll. Unfortunately, the project was never realised due to its anticipated performance falling significantly short of contemporary fighter aircraft.

The L-39R reconnaissance (Rozvědka, meaning 'intelligence' or 'reconnaissance') model, derived from the A-139, also failed to reach serial production.

The only originally proposed special variant to reach the development stage was the L-39V (Vlečný, meaning 'towing'), which was eventually realised. In the early 1970s, the Czechoslovak Air Force sought a replacement for the MiG-15T and MiG-15bisT aircraft used to tow KT-03 aerial targets. These aircraft had been delivered in limited numbers - twenty-four units in total - during the late 1950s and early 1960s. By the early 1970s, their service life was nearing its end, and only half remained operational. Moreover, their performance was inadequate for training engagements with modern fighter and interceptor aircraft.

It was decided to modify the L-39 for

Above: A serial L-39V operated by the Czechoslovak Air Force with the KT-04 towed target positioned in front. Note the empty rear cockpit, where the reel was installed.

target towing. From the outset, it was clear that only a limited number of aircraft would be converted, necessitating a simple and cost-effective solution. The chosen approach involved adapting the towing equipment removed from the MiGs to the L-39 airframe. Design work on the new L-39V variant began in 1970. A year earlier, a team at Rudý Letov, led by Jan Franc, had begun developing a new training target designated KT-04. The target first flew in 1971, towed by a MiG-15bisT, but early tests revealed the need for shape modifications.

To validate the L-39 towing concept, the X-08 prototype, which was undergoing installation of the AI-25TL engine at the time, was selected. The rear cockpit equipment was completely removed, and a drum containing a 1,500-metre-long steel cable (5 mm in diameter) and an electric winch was installed. The drum was tilted 30° rearward relative to the aircraft's longitudinal axis. The cable was fed through a hole in the starboard floor section to a guide rail beneath the fuselage.

Right: An OEM's flight line featuring the X-39 prototype - the first L-39 equipped with a GSh-23 cannon, marked 'L-39B' on the tail fin. Behind it are parked Czechoslovak L-39V and Iraqi L-39C and ZO aircraft awaiting delivery.

Emergency scissors for cutting the cable were mounted under the rear wing section. Beneath the fuselage, at the level of the forward cockpit, a domestically produced L-03 ram turbine was installed. This powered the winch via a separate circuit, ensuring it did not draw power from other onboard systems during cable winding. The turbine also acted as a brake during cable deployment. The ASP-3NM/U-39Z sight and FKP-2-2 gun camera were removed from the front cockpit, along with the RSBN-5S navigation system. In place of the sight, a combined control panel and rope-winding indicator were mounted on the dashboard frame. Due to the absence of a large sight, the L-39V variant offered the best cockpit visibility of all versions. Both cockpits also lost their pressurisation systems, as low-altitude flight and no aerobatics were expected.

Ground tests of the towing system took place in August and September 1972, coinciding with the availability of the first KT-04 targets. Based on initial results, the aircraft configuration was slightly modified.

Right: A test firing of two R-3 missiles during a combined gunsight and engine surge trial. Although the launchers are positioned well away from the engine intake, the missiles could potentially cross the jet's airflow path.

Below: The L-39X-10 prototype in L-39ZA configuration, with the cannon clearly visible under the nose, captured during altitude testing near the High Tatras Mountains.



Right: A L-39ZA prototype cockpit. Note the weapon control panel on the port side. On the far left is a test panel allowing test pilots to operate new systems and start or stop data recording.

Flight-testing began in October and comprised forty-five flights, the majority involving target towing. Test crews developed a towing procedure in which the aircraft unwound 100 metres of cable on the ground before taking off with the target mounted on a launch trolley.

The flight envelope was limited to a maximum speed of 500km/h and a g-load of +6/-3g. Before the end of the year, the X-08 prototype was withdrawn from testing for use in other trials. It returned in July 1973 to participate in military evaluations, which concluded in April the following year with a recommendation for service adoption - both for the aircraft and the KT-04 target.

In 1975, following an order from the Ministry of National Defence, construction of eight L-39V towing aircraft commenced. These were delivered the following year and gradually replaced the ageing MiG-15bisT fleet. After further modifications, a new methodology for target towing flights was developed. Upon take-off at 210 km/h and reaching an altitude of 80 metres, sensors on the target's trolley detected lift-off and triggered release of the trolley and deployment of its braking parachute. In flight, the target had minimal impact on aircraft handling, though rapid deceleration had to be avoided. For example, if the pilot deployed speed brakes too quickly, the target could surge forward, risking contact between the cable or target and the aircraft's control surfaces or fuselage. To mitigate this, the cable attachment mechanism was fitted with a sensor that released the target if the cable was unloaded for more than five seconds.

Due to the cable's weight, the target flew



several tens of metres below the aircraft. It contained a device that recorded bullet strikes, with data analysed post-flight. After the shooting exercise, the target was reeled in to a distance of 150 metres and released from the tow cable. It then landed via parachute onto an inflatable cushion integrated into its fuselage. The aircraft continued flying; the pilot wound the cable to 50 metres, and proceeded with a standard landing.

Initial experience with L-39 prototypes revealed that the existing weapons load capacity and armament configuration could be limiting for many potential customers. This was confirmed by reports from the monopoly foreign trade company Omnipol, whose sales representatives frequently advocated for a training version with secondary light combat

capability. As a result, development of the L-39Z variant (Zbraně – Weapons) commenced in 1973, intended to support extended weapons training and light combat operations. Development was divided into two stages. The first involved strengthening the wing, which was newly equipped with four pylons instead of two. Following this modification, the aircraft was designated L-39ZO. The wing was also fitted with fuel systems allowing the carriage of up to four auxiliary fuel tanks. The first aircraft to meet the ZO specification was the flight prototype X-09, flown by Juraj Šouc in Vodochody on 25th June 1975.

Testing focused on evaluating the wing's performance with four pylons and the impact of armament use. Armed with UB-16-57UMVP blocks carrying S-5 unguided rockets, the aircraft underwent a series of tests to assess the effect of firing on engine performance across various flight modes. Simultaneously, the influence of auxiliary fuel tanks on range and flight behaviour was examined. Emergency jettison procedures were also tested extensively, requiring dozens of flights. Tanks with capacities of 150 and 350 litres were trialled; both full (using water for testing) and empty.

During emergency jettison tests, it became apparent that the tanks tended to rotate after detachment, risking collision with the wing near the flaps. After wind tunnel testing, flight trials, and measurements, this issue was resolved by fitting stabilising surfaces to the rear of the tanks. As the new wing increased the aircraft's empty weight, the original landing gear was also tested. It passed without requiring reinforcement for the ZO version.

The X-10 prototype, also flown by Juraj Šouc on 26th March 1976, participated in L-39ZO testing. By June 1976, combined factory and control tests were completed, revealing no significant performance

Above left: The L-39X-11 prototype in a special test paint scheme, shown with auxiliary fuel tanks and R-3 missiles.

Left: The same aircraft, this time equipped with four UB-16-57 pods for unguided 57mm calibre rockets. Each L-39 could carry up to 64 unguided rockets.





Above: A late L-39ZA.4 aircraft with clearly visible Bendix-King wire antenna and additional VOR/ILS antennas on the tail fin - a rare fusion of Eastern jet design with Western avionics.

cannon was selected as the most suitable weapon. At the time, it was a highly modern and powerful system used on several Soviet aircraft.

Installing the cannon required redesigning the nose to accommodate a 150-round magazine. Antennas for the marker, radio compass, and radio altimeter were relocated to make space. A cooling air duct was moved to the port side of the fuselage to cool the converters, as its original location was taken by the ammunition box. The jack foothold and IFF antenna were also repositioned, now located beneath the cannon barrels.

To protect the fuselage from hot exhaust gases during firing, stainless steel plates were fitted to the nose landing gear doors and surrounding fuselage skin. Due to the expected weight increase, the undercarriage was modified with wider wheels and reinforced brakes featuring additional discs. The cannon was first installed on the decommissioned X-03 prototype in early 1974, which was then used for ground and bench testing. Three prototypes were selected for flight-testing of the modifications. The X-09 was the first to fly with the cannon installed. The X-10 was also fitted with reinforced undercarriage wheels and modified wheel wells and covers. While undercarriage testing proceeded without incident, the cannon installation required several design changes. Firing the cannon negatively affected engine intake pressure, causing overheating and potential surging. Designers repeatedly altered the muzzle compensator's shape, but the issue persisted. Ultimately, an angle-of-attack sensor was installed on the

Left: Detail of the GSh-23L cannon with visible ammunition. The magazine held only 150 rounds, sufficient for two or three attack sorties.



degradation compared to the L-39C, aside from a slight increase in drag due to the pods. The variant was then offered to customers. Iraq was the first to place an order, receiving its initial L-39ZOs in 1976, even before state trials concluded. Libya, Syria, and East Germany followed with orders. In total, 376 aircraft of this version were produced, with the final units delivered to Iraq in 1985.

The ZO version was produced in several standards. The L-39ZO.1 subversion was delivered to Libya, Syria and East Germany and was fully equipped, with the exception of Libya, whose aircraft lacked the Kvant system but had an extended emergency survival kit that included an inflatable life raft and a life jacket.

The L-39ZO.2 was acquired only by Syria, and these were aircraft without the

RSBN system. The L-39ZO.4 and ZO.5 were purchased by the GDR and represented an improved standard of the original L-39ZO.1, with various enhancements according to specific customer requirements, such as different connectors for connecting a ground power source or the Kvant system.

The final sub-versions were the L-39ZO.6 and ZO.7, which were acquired by Iraq and were characterised by the absence of the RSB system, the installation of older RTL-11 radios, and an extended emergency survival kit adapted for operation over desert areas. The ZO.6 also lacked the Kvant system.

The second stage of L-39Z development involved using the reinforced wing from the ZO version and installing a rapid-fire cannon beneath the fuselage. After thorough analysis, the 23mm calibre twin-barrel GSh-23L



port side of the nose to automatically block firing at high angles of attack, ensuring safe engine operation.

In 1977, the X-11 prototype joined the test programme, flying for the first time on 16th May. It was the final L-39 prototype built, followed by pre-series and production units. The X-11 also tested new pods, including the PFK-5 photo container with five AFA-39M

Below left: Serial L-39ZA.7 cockpit featuring an additional fee-calibrated altimeter on the top panel - a typical Warsaw Pact solution enabling jets to fly under NATO standards using imperial units.

Below right: Rear cockpit of the L-39ZA.7, again with a secondary altimeter calibrated in imperial units. Despite being armed, the central panel still allowed instructors to insert simulated 'errors' into the front cockpit instruments.

cameras, mounted on the port inner pylon, with a 350-litre fuel tank symmetrically installed under the starboard wing. Aero aimed to expand the aircraft's reconnaissance capabilities with this configuration. The container enabled vertical and oblique imaging at altitudes from 200 to 10,000 metres (although the L-39ZO/ZA could not reach the upper limit). Later, the use of two or even four reconnaissance containers was considered. For reconnaissance missions, the cockpit was equipped with a camera control system and an MS-61 tape recorder for voice command and commentary recording. During testing, two podded PK-3 machine gun containers were also trialled, each housing three 7.62 mm URZ machine guns (later Vz.77), with 1,500 rounds and a

Above: This particular L-39ZA.4 was essentially a serial L-39ZA model used for testing Western avionics. After testing concluded, the aircraft was repurposed for marketing flights.

theoretical firing rate of 2,500 rounds per minute. The control system allowed synchronisation with the GSh-23 cannon. However, these machine guns remained at the prototype stage due to various limitations.

The X-11 was showcased at the Paris Air Show in summer 1977, painted in elegant blue-grey camouflage with red accents, bearing civilian registration OK-HXA and exhibition number 336 on the nose. It carried two auxiliary fuel tanks and, for two days only, a reconnaissance pod with a symmetrically installed tank on the



opposite wing. It did not carry the GSh-23 cannon at the show and thus corresponded to the L-39ZO configuration. Pilot Juraj Šouc demonstrated the aircraft, and its aerobatic capabilities were praised by the Western press.

At the end of 1977, the same prototype completed military testing. Afterwards, it was sent to the USSR for evaluation, flying in its original camouflage with Soviet insignia and the red number '79'. Although the USSR considered expanding weapons training on the L-39, it ultimately opted not to procure any armed variants, continuing instead with the more economical L-39C.

In addition to deliveries of serial L-39C, L-39ZO and L-39ZA aircraft - featuring minor differences primarily related to

adapting the aircraft to operational conditions at the customer's site - Aero began work in 1985 on a new version of the L-39ZA.4 for Nigeria. Nigeria was the first foreign customer to request a fundamental modification of the avionics. Notably, the supplier chosen was Bendix King, a company from the capitalist United States - a remarkable choice given the geopolitical context of the time. The modification included the installation of three independent radios (two of Czechoslovak origin and one shortwave KHF 950 type from the USA), VOR/ILS navigation system KNR 634, DME KDM 706, gyromagnetic compass KCS 305, backup radio compass KDF 806, and transponder KXP 756. Dashboard indication was provided by the KPI 552 combined

navigation indicator and the KNI 582 radiomagnetic indicator. Due to the installation of these components, the aircraft's centre of gravity shifted, which was compensated by relocating the hydraulic accumulator to the nose of the fuselage.

For Aero, this marked the first 'Westernisation' of the L-39 - a challenging task given the bipolar division of the world and limited access to Western technologies at the time. All modifications were tested in Czechoslovakia on the L-39ZA.4 prototype, serial number 533216, which remained with the manufacturer after testing and was later sold to the USA post-1990, where it flew under the registration N92JJ.

The first major post-revolution development of the L-39 in the early 1990s was initiated by Thailand. The Royal Thai Air Force appreciated the L-39 but required integration of Western avionics and armaments to facilitate its inclusion in their training system. For this project, Aero collaborated with Israeli company Elbit, which served not only as the final supplier but also as the integrator, ensuring compatibility with Thailand's F-16A/B and F-5 aircraft. Elbit codenamed the project 'Venus'.

To support marketing efforts, Aero sent

Left: Rear cockpit of the L-39ZA/ART, also modified with a small MFD installed on the right side. This model introduced toe braking, replacing the previous grip on the control stick.

Below left: A completely different L-39ZA/ART front cockpit, featuring a HUD display, UFCP panel, and Western-style instruments.

Below: An OEM-owned L-39CA aircraft used for testing a locally developed Czech HUD display. Due to limited avionics functionality, its UFCP panel featured only a few buttons. Note the additional Garmin navigation suite.



the L-39ZA.7 aircraft, coded 5240, to the Asian Aerospace exhibition in Singapore in 1992. The aircraft, previously designated OK-186, was used for development testing and promotional activities. Its demonstration significantly contributed to securing the Thai Air Force's order. The Thai variant, designated L-39ZA/ART, was based on the L-39ZA but featured substantial upgrades. The front cockpit was equipped with a HUD and Up Front Control panel, complemented by modern instruments calibrated in Anglo-Saxon units. The rear cockpit included a repeater display. This was the first L-39 model to feature a HUD; previous versions used only collimator gunsights.

The upgraded weapon navigation system included a mission computer, inertial navigation system with laser gyroscopes, US-made ARC-164(V) and ARC-186(V) radios, KPX-756 transponder, and TACAN navigation system KTU-709. The L-39ZA/ART also incorporated innovations from the concurrently developed L-39MS project, such as a closed hydraulic system pressurised with inert gas, a modern flight data recorder, and brake control via pedals rather than a lever on the control stick. The control stick grips were customised for the Thai pilots, featuring smaller handles than standard.

The integration of Western avionics resulted in a reduced empty weight. Armament was expanded to include AIM-9P Sidewinder IR-homing missiles, Mk.81 and Mk.82 unguided bombs, Dart training towed targets, four 350-litre auxiliary fuel tanks, and other equipment. Pylon locks were modified to accommodate Western armaments.

As the airframe remained largely unchanged, testing focused on verifying avionics functionality and reliability. Most modifications were trialled on aircraft 5240. Test flights were conducted by Aero pilots

Miroslav Schützner and Vladimír Kvarda, alongside Elbit representative and former Israeli Air Force pilot Yehuda Shafir. Live weapon testing began in May 1993 at the Malacky range in Slovakia, where regulations were more permissive than in the Czech Republic. Initial tests involved the GSh-23 cannon to validate HUD targeting. Mk.87 bombs - used for training in Israel and resembling Mk.82s - were also tested but discontinued due to suboptimal ballistic similarity. Ten flights were conducted between 13–19 May, focusing on cannon accuracy and the impact of firing vibrations on avionics.

In June, aircraft 5240 flew to Israel, landing at Uvda Air Base after several stopovers. There, fifty-four flights were conducted over one month to test jettisoning of Mk.82 inert and retarded bombs, Mk.117 bombs, CBU-58 cluster munitions, BDU-33 training bombs, and 70mm unguided rockets from LAU-61 and LAU-68 launchers. SUU-20 training pods were also tested.

During AIM-9P3 Sidewinder missile tests, one LAU-100 launcher failed. As an emergency solution, a launcher was borrowed from a South Vietnamese F-5 aircraft housed at the Prague Kbely Museum. Despite the F-5 having been grounded for two decades, Israeli specialists approved its use. Yehuda Shafir then made history by firing a Sidewinder from a Czech (and Eastern Bloc) aircraft over the Mediterranean Sea.

The tests validated weapon integration and assessed the impact of firing on the engine and other systems. Aero's factory crew flew alongside Thai and Israeli pilots. The successful trials enabled aircraft delivery to Thailand, although initial deliveries required software updates based on Israeli test data. Aircraft serial number 365605, completed in March 1997, became the final L-39 ever produced. Prototype 5240 was later sold to the USA, where it flew under registration N39ZA.

The last major serial modification of the L-39 was for Bangladesh, whose air force

required a rescue system capable of zero-altitude, zero-speed ejection. Drawing on experience from the L-39MS and L-139 models equipped with VS-2 and VS-2A seats, Aero installed VS-2A seats in the L-39ZA.9. At speeds above 150 km/h, ejection occurs after canopy jettison; below that, ejection is possible through canopy transparencies. Development and testing took place in 1994–1995, and the system's safety was validated through documentation, eliminating the need for live ejection tests. To this day, Bangladesh's L-39s remain the only ones equipped with zero-zero ejection seats.

The L-39ZA version was completed in 227 serial units, the first of which were received by the Czechoslovak Air Force in 1980, and a year later by the first foreign customer, Romania. Subsequently, this variant was exported to Bulgaria, Syria, Nigeria and Algeria, and after 1989 to Thailand, Bangladesh and Lithuania. Even the L-39ZA variant was produced in several subversions. The L-39ZA.1 was adopted as the default standard by Czechoslovakia, Romania, Bulgaria and Algeria. The L-39ZA.2 was purchased only by Syria and was an aircraft without the RSBN system. The L-39ZA.4 refers to aircraft equipped with communication and navigation systems from the Western company Bendix King. Only Nigeria originally purchased this model, but some of the ordered aircraft were never delivered and were later resold by the manufacturer to Algeria, Bangladesh and Lithuania. Only Czechoslovakia received the L-39ZA.3, ZA.5 and ZA.7 standards. In the first case, these were aircraft equipped with the SDU command control system and prepared for performing electronic warfare tasks (which ultimately never occurred); in the second case, aircraft equipped only with the SDU system; and in the third case, aircraft fitted with the LPR-80 radio station instead of the R-832. Another subversion is the L-39ZA.9, which was ordered only by Bangladesh. The specific L-39ZA/ART variant was acquired solely by Thailand.

Below: Serial Bangladeshi L-39ZA.9 aircraft, with distinct VS-2 ejection seats visible in the cockpits. Otherwise, the aircraft matches the L-39ZA.4 standard.





A SECOND LIFE

At the end of the 1970s, the airframe of the X-12 prototype was used for long-term fatigue testing, necessary to prove the declared technical service life of the L-39. Since the beginning of the 1980s, a number of L-39 development concepts were explored at the Aero development centre, starting with the L-39B special photo-reconnaissance aircraft with cameras in the rear cockpit, followed by versions with different armament configurations or a variant designed for electronic warfare. However, none of these were ever built, although they were occasionally assigned version designations.

At the end of the 1970s, the Soviet Air Force began preparing for the anticipated

mass arrival of a new generation of multirole fighters such as the MiG-29 and Su-27. It was clear that a new training system needed to be developed, as the L-39-based system had become too far removed from these new frontline fighters in terms of onboard equipment. Using the L-39s for Su-27 pilot training - although it did eventually happen - was considered too great a leap for young pilots, particularly given that the Soviet Air Force was largely built on the conscription model. Financial considerations were also evaluated, as the new fighters were deemed expensive to operate, and training tasks were therefore to be carried out on a more affordable and accessible type. The Aero factory, by then well established as the monopoly manufacturer of training aircraft

Above: The first L-39MS prototype, known as L-39X-21, still powered by the Al-25TL engine of the original L-39 series.

for the USSR and Warsaw Pact, was approached via Soviet state authorities with a request to develop a project for an aircraft designed to train pilots for the new generation of frontline fighters. As the USSR was entirely satisfied with the L-39C aircraft - whose design potential was widely regarded as not yet fully exhausted - the preferred approach from the outset was to substantially enhance the aircraft's performance and retrofit it with new onboard systems capable of preparing pilots to operate the MiG-29 and Su-27 series. The requirements for the new aircraft included improved flight performance, greater operational safety, enhanced instructor visibility from the rear seat, installation of a piloting and navigation system with weapons aiming and computing capability, and increased payload capacity. From the beginning of development, it was assumed that foreign customers outside the USSR would also be interested in the new aircraft.

In the early 1980s, initial studies of the new aircraft were prepared. One alternative, designed especially for training without extensive use of armament, was an L-39 project featuring a differently shaped cockpit similar to that of the Dornier Alpha Jet. However, following internal design reviews, the concept of a deep modernisation of the L-39 type prevailed. The new aircraft was named the L-39MS (Modernizovaný Standard – Modernised Standardised), and the concept retained the main structural units, which was seen as a way to reduce both cost and development risk. This solution was further considered effective due to the ease of transition for pilots from legacy L-39Cs - now reassigned to elementary training - to the new L-39MS model. The concept also allowed for the continued use of existing maintenance

Above left: The new cockpit section labelled L-39M, although this was later redesignated L-39MS. Note the stepped cockpit.



Left: A testbed airframe for DV-2 engine testing (as written on the tail in Cyrillic), with pantograph hinge redesigned for the Tu-16LL bomb bay.

Right: Soviet Air Force Tu-16LL flying laboratory operated by the LII institute, with the L-39 engine testbed airframe protruding from the bomb bay.

facilities by the USSR's primary user, thereby reducing the time required for introduction.

Following the completion of initial conceptual studies and reports, design work commenced, during which several aerodynamic models were produced. One of these, at a scale of 1/7, was subsequently tested in the wind tunnel of the TsAGI institute near Moscow, while scale models of the aircraft and wing were also tested in wind tunnels in Prague and Dresden.

A prerequisite for achieving the desired performance increase was the use of a new engine. The most promising candidate was a projected Soviet turbofan engine of a new generation, developed by the OKB-478 design bureau (later ZMKB Progress) under the leadership of chief designer V. A. Lotarev (later succeeded on the project by F. M. Muravchenko). In October 1980, an intergovernmental agreement was signed between Czechoslovakia and the USSR for cooperation on the development of an engine designated DV-2 (D for Dnieper, V for Váh - rivers in the USSR and Czechoslovakia), which was to be produced in Czechoslovakia.

The requirement for domestic production stemmed from experience with the AI-25TL engine used in the L-39, which had seen little modernisation beyond extended maintenance intervals during production. Domestic production in Czechoslovakia was seen as a guarantee that the engine would be continuously improved, with more powerful versions planned. The agreement included a commitment from the Soviet design bureau to finalise development to meet thrust and



servicing interval requirements, while the Czechoslovak side was responsible for creating the production technology and manufacturing the engine, down to aggregates, components and individual parts.

By October 1981, Czechoslovakia had received the design documentation for the new engine. The development and layout of production facilities was entrusted to the Czechoslovak VÚM institute (Výzkumný ústav motorů - Engine Research Institute), which became part of the Povážské strojírny Company (PS), later the OEM of the engine. At the time, PS formally belonged to the ZVL Povážská Bystrica machinery consortium, which had virtually no prior experience in

aircraft component production. However, under the internal political rules of the Czechoslovak federation, the Slovakia-based plant was selected to balance industrial projects between the federal republics. It is recorded that a senior company manager once remarked that, having successfully designed a two-speed moped, the company was expected to build a jet engine - clearly unaware of the complexity of the task, as were many of his colleagues. Other Czechoslovak companies were responsible for developing and producing engine components, including a sophisticated control system.

Between 1982 and 1987, a total of sixteen prototype engines were produced through joint efforts by Czechoslovak and Soviet companies, with the seventeenth engine manufactured entirely in Czechoslovakia. Introducing production of such a sophisticated product into a company with no prior experience understandably resulted in significant delays in development and manufacturing. However, delays were also caused by design changes requested by the Soviet side - over seven thousand in total - alongside a further three thousand domestic changes. Extensive and highly modern technical facilities were built in Slovakia for engine testing and production. In 1984, the first prototype engine was tested on a technical bench in its complete form, as only assemblies had been tested previously. Subsequent DV-2 tests included runs in an L-39 airframe mock-up mounted beneath the Tu-16LL flying laboratory (fuselage number 'blue 10') operated by the Moscow-based aviation research institute LII. The mock-up, consisting of a modified L-39 fuselage with classic split canopies, was mounted on a retractable beam in the bomb bay. Tu-16LL flights were used to verify in-flight operation of the DV-2 engine, including repeated in-flight starts.

Above left: Second flying L-39MS prototype featured various camouflage schemes, pictured here during the Memorial Air Show at Roudnice nad Labem, a small grass airfield. The grass strip take-off was very spectacular, especially in dry or wet terrain.

Left: The third X-24 prototype. Only a few photos of this jet are available, as it crashed tragically in 1992.



Right: Last L-39MS prototype in a camouflage scheme designed for its expected customer – the Soviet Air Force. The jet even featured Russian stencils.

The result of this demanding development process was a modern engine with a thrust of 21.58kN - almost one-third more than the original AI-25TL. Several years later, by a twist of fate, the same engine was used to power the prototype of the Yak-130 jet trainer.

The assembly of the first L-39MS prototype, later given the marketing name Super Albatros, began in 1985. Compared to the original L-39ZA version, it differed in terms of airframe and onboard equipment. The DV-2 engine was paired with the new Safir 5M APU, which had the capability to function as an emergency generator and eliminated the need for the pop-up ram air turbine beneath the fuselage. The airframe differed mainly in the modified front section of the fuselage. It featured wider cockpits with a hydraulically driven, rearward-opening canopy shared by both cockpits. The instructor's seat in the rear was positioned significantly higher to improve visibility. Both cockpits were fitted with new VS-2 ejection seats capable of rescuing pilots at zero altitude and zero speed. Their development was carried out under the auspices of Aero and they were fully certified after 130 test ejections in 1990. Compared to the L-39, the ability to eject the crew even at zero speed was achieved by installing rocket charges on the underside of the canopy. This meant that airflow was not required to carry the canopy clear of the ejection path.

The aircraft's wing, along with the airframe, was reinforced using new construction materials, resulting in an almost 50% increase in load capacity. This, of course, necessitated modifications to the landing gear, as the aircraft's weight increased by nearly a quarter following all the upgrades. The structural reinforcement allowed the technical service life to be extended to 4,500 flight hours, with the possibility of further extension to 6,000 hours depending on how a particular aircraft was flown and stressed. The aircraft's

Below: The very first serial L-39MS with fuselage code 0001 (and exhibition code 367 for the Paris Air Show). Yet even before its first flight, it was obvious the Soviet Air Force would not take over a single airframe.



controls also underwent changes. The flaps were redesigned for maximum extension to 55°, compared to the original 44°, and the ailerons were now hydraulically boosted, along with the elevator. The wingtip tanks were replaced with a larger type, each holding 230 litres of aviation fuel, increasing the wingspan by ten centimetres. However, the most significant change occurred in the cockpit, which bore no resemblance to the original L-39 versions.

The basis of the avionics was the On-Board Electronic System PES (Palubní elektronický systém), featuring an onboard computer that integrated data from all sensors and connected them to outputs on various indicators. For example, the front cockpit was equipped not only with backup analogue flight instruments but also with a CRT screen of a multifunctional display system and a Czechoslovak-made HUD (head-up display). Thanks to the significant height difference between the two cockpits, the HUD was also visible to the instructor in the rear seat, which was highly advanced compared to the repeater systems commonly used elsewhere. Both the HUD and the display were capable of fully presenting navigation and weapon data, and the instructor could introduce errors into the indications in the forward cockpit for training purposes. Flight data was displayed in a

format corresponding to Soviet standards, allowing the student to practise navigation and weapon tasks in such a way that, upon transitioning to the final aircraft type, only the specifics of its control needed to be learned. The aircraft included a number of other modern systems, including the PARES (Palubní Registrační Systém – Onboard Registration System) flight data recorder, which was extremely sophisticated for its time and well ahead of systems introduced on the Su-27 family and others. The data was available for post-flight debriefing, which increased training efficiency - though not all pilots appreciated this, as it marked the end of carefree flying.

The armament of the L-39MS was inherited from the L-39ZA model, including the R-3 guided missiles. Additionally, it featured Czechoslovak LRM-122 rocket pods for four 122 mm calibre unguided LR-122 rockets each, although these were not widely used. A new feature in the armament was its control system, which used either the multifunction display or the HUD, and introduced new aiming and firing modes, such as the combined use of multiple types of ammunition either simultaneously or in quick succession (e.g. firing unguided rockets followed by bomb release).

The L-39MS was intended as an



Right: Last Czechoslovak L-39MS with code 0006, armed with two R-3S missiles and two UB-16-57 unguided rocket blocks.

advanced training aircraft, to be used after pilots had mastered the basic L-39. The plan was to keep both jet models in production simultaneously and benefit from the synergy of both concepts. At the beginning of the 1980s, a full-size mock-up of the front fuselage was assembled to verify the layout of future cockpit equipment. It bore the rather confusing title L-39M, a name that was never used again. Testing of L-39MS systems was distributed across several prototypes, including those based on standard L-39s. In early 1983, the L-39 X-09 aircraft (the L-39ZO prototype described above), registered OK-186, was assigned to VZLÚ as the first L-39MS testbed. It was equipped with elements of the developing PES onboard electronic system, which controlled the avionics and engine, as well as new VS-2 ejection seats with expected zero-zero characteristics. For testing purposes, it was fitted with additional probes.

The VS-2 seat was also tested in a special flying laboratory made from a modified Mach 2 MiG-21U, fuselage number 0981 (registered OK-016 at VZLÚ), from which the first VS-2 test ejection took place on 15 April 1983. The first L-39MS prototype, internally designated L-39X-21 and registered OK-002, flew for the first time on 30 September 1983, piloted by company test pilot Miroslav Schützner. It was close to the final configuration, but due to delays in DV-2 engine development and production, it was still powered by the original AI-25TL engine. The aircraft flew for a long time with the rear cockpit filled with a new generation of flight test and measuring equipment, while the front cockpit featured a prototype avionics installation without a HUD. It was the last flight witnessed by chief designer Jan Vlček, who tragically died on 2nd January 1984. Work on the L-39MS was subsequently taken over by his colleague Vlastimil Havelka.

Tests with the original engine were mainly used to complete the development of the onboard avionics and verify the airframe modifications. On the last day of September 1986, the second prototype, L-39X-22, registered OK-180, was flown for the first



time, this time equipped with the prototype DV-2 engine. It was again piloted by Miroslav Schützner. The following year, two more prototypes, X-24 and X-25, were completed, while X-23 was used for static airframe testing at VZLÚ.



Even before the end of the testing phase, assembly of the first pre-series models, designated L-39MS.1, was launched. These received serial numbers 001 (later 0001) to 0006. The first of them flew for the first time on 1st October 1989. The initial series was intended to develop methodologies for training and combat deployment of the L-39MS type, as well as for military testing. At the same time, testing of the VS-2 ejection seat was successfully concluded. Unfortunately, during the late development phase, the X-09 prototype was lost on 8th April 1986. After a test ejection of the VS-2 seat at an altitude of 300 m and a speed of 350km/h, the engine RPM dropped abruptly and then stopped entirely. Test pilot Jiří Pospíšil opted for an emergency landing and brought the aircraft down on a grass strip at Sazená airfield. During touchdown, the tail section struck the terrain violently and separated from the airframe. The pilot survived with serious injuries, but the aircraft was damaged beyond repair.

In the late 1980s, state tests of the DV-2

Left: The second serial L-39MS with fuselage code 0002 in Czechoslovak Air Force colours. This paint scheme was unique and used only on this jet.



engine had already been completed in the USSR, which was a prerequisite for the introduction of the L-39MS type into service. However, even before the end of 1989, it became clear that in the climate of Perestroika, the Soviet Air Force would not be able to order new aircraft produced by Aero in large quantities, and there was already open discussion about the decline in orders for the existing L-39Cs. It was evident that the economic problems of the USSR would

almost certainly prevent the purchase of the much more expensive L-39MS type. Although the Soviet Union was originally expected to be the main customer - and even the concept of the L-39MSV aircraft for target towing, and special variants for reconnaissance and electronic warfare had been developed for it - in the end, the L-39MS was not even tested in the USSR, and the Warsaw Pact countries did not have time to express interest.

Above left: The Czechoslovak L-39MS front cockpit with large HUD and CRT displays. Note the control stick is on a pedestal with a wider movement range compared to a conventional stick.

Above right: Rear cockpit of the Czechoslovak L-39MS model. Note even the rear cockpit featured a HUD, as it was high enough to see through it.

The events following the end of 1989 ultimately ended the L-39MS's prospects in eastern markets, and the type was demonstrated in 1991 under the export name L-59 in the West at the Paris Air Show (the L-59 designation had previously been used in the 1960s for a combat aircraft project). At that time, it was a pre-production L-39MS.1 0001 with the number 188 on the fuselage. Aero continued to develop the aircraft, and in 1990 it finally secured a formal order for five serial L-39MS.3 units (the new name reflected some configuration changes required in the meantime) from the domestic Ministry of Defence, with plans to acquire more in subsequent years. One additional aircraft, the 0001 unit, had already been handed over, bringing the total order to six, some of which had already been produced. The first pre-serial unit, number 0002, was completed in January 1992, and the last in June of the same year. All were taken over by the Czechoslovak Air Force, which also introduced the aforementioned pre-series 0001 specimen into its inventory.

Since the late 1980s, the X-22 prototype, newly designated 0022, had been involved in tests of the armament control system,

Left: The L-59E prototype number 0101 during GSh-23L cannon firing. The expelled shells are ejected and are visible in the picture.



Right: The L-59E prototype with SUU-5003 training dispensers, of western origin, for four 2.5-inch unguided rockets and training BDU-33 bombs.

including participation in test firing over the Malacky range in Slovakia. Unfortunately, for the second time, political events intervened in the fate of the aircraft. During the dissolution of the Czechoslovak Federation, two L-39MS aircraft were transferred to Slovakia and four remained in the newly formed Czech Republic, as federal assets were divided in a 2:1 ratio. In the first half of the 1990s, both countries began reducing the number of Warsaw Pact-era systems in operation, and the L-39MS type saw only brief service in either country, as operating such a modern and sophisticated type in small numbers was not economically viable. Nevertheless, two more L-39MS prototypes were flown, numbered 0101 and 0102, both of which remained with the manufacturer due to the lack of customer orders. They were from the first (01) series and were considered to be in full serial configuration. The other five airframes under construction were not completed. The third flight prototype, X-24, was destroyed on 11th September 1992 during training in advanced piloting techniques. Test pilot Karel Pánek and technician Jiří Chvojka were killed. The exact cause of the catastrophic accident

Below left: Tunisian L-59T front cockpit. Note the small displays – a very modern feature in the mid-1990s when the jet was originally delivered.

Below right: Tunisia requested a HUD repeater instead of the HUD itself, so the cockpit differs from the L-39MS standard due to the large CRT screen.



remains uncertain, with speculation pointing to G-LOC of the pilot in a test configuration aircraft with no controls in the rear cockpit.

Specifically for the L-39MS, a TL-39MS simulator was created by Rudý Letov. The simulator was controlled by the ADT 4500 computer manufactured by the local company ZPA Turnov and was by far the most modern simulator in the Eastern hemisphere. It projected terrain onto three areas in front of the cabin. A further innovation was that the landscape image was no longer taken from an 'infinite' strip with airfield paint, but was generated by software, allowing simulation of day, night, and adverse weather conditions. The hydraulic base featured a moving mechanism that more accurately simulated the

sensations experienced by the pilot during aircraft movement. The operator's station was fully digital, with CRT computer screens. At the beginning of L-39MS development, the simulator was used for various tests of real aircraft systems and helped fine-tune the jet. The only existing TL-39MS simulator cockpit was identical to that of the X-24 prototype. Although a second simulator was originally intended for the Czechoslovak Air Force, the breakdown in relations between the simulator manufacturer and Aero in the early 1990s led to a situation where Letov (now missing the word Rudý - Red - from its name) was unable to convince the domestic customer to purchase it. As a result, the prototype simulator was stored at the manufacturer's



Right: The L-59T prototype with flags of Czechia, Slovakia, Egypt and Tunisia – the only L-39MS/59 operators. This aircraft remains stored with the OEM to this day.

Below right: Sister ship 0102 in this demo paint scheme. After the end of the L-39MS/59 programme, it was used for testing components for the L-159 model.

facility and later rebuilt into a modernised version, the TL-39M, designed for training L-39 pilots. After 1990, the advanced TL-39M for legacy L-39s was delivered in limited quantities to some foreign customers as a modernisation of older TL-39s.

Alongside the L-39MS model, the OEM decided to further utilise the existing L-39 concept, and in mid-1990 launched a programme for the ‘Westernisation’ of the Albatros. After all, the type was one of the most versatile and successful jet trainers globally, and the fall of the Iron Curtain allowed exports to previously inaccessible countries. One of the leading ideas behind the project was the American JPATS (Joint Primary Attack Training System) programme. Several internal layout proposals were considered, with the L-39G3A variant - proposed to be powered by the Garrett TFE 731-4-1T engine with 18.15kN thrust - emerging as the winner. The same engine, also used in Spanish C-101 Aviojet trainers, offered 15% lower fuel consumption and significant weight savings, both due to its lighter weight and the possibility of eliminating the APU, as the new engine used electrical starting.

The new type was named L-139 and nicknamed Albatros 2000. Under the leadership of chief designer Dobroslav Rak, the team also chose to use VS-2A ejection seats with zero-zero parameters, an onboard oxygen generation system, and Western avionics proposed by Bendix King and Flight Vision. This avionics suite was later used in the L-59E model for Egypt, described later. The flight symbology on the newly installed HUD and MFDs was designed to mimic that of F/A-18 fighters. The jet was equipped with

Below: The L-139 prototype number 5501 with exhibition code 363 for the Paris Air Show. Note the ‘PATS’ stencil on the nose – the OEM had ambitions to propose it for the US Primary Attack Training System competition.



Western-standard weapon racks and was later cleared for use with Canada’s 70mm (2.75inch) calibre CRV-7 unguided rockets. For cost reasons, the Russian-origin GSh-23L underbelly cannon was retained.

In 1992, construction of two prototypes was launched, but only one, with fuselage code 5501, was completed due to budget constraints. Final assembly was hectic, as the new model was scheduled to be unveiled at the Le Bourget Air Show in Paris in June 1993. The first flight took place on 8th May 1993, with pilots Ladislav Šnýdr and Stanislav Vohanka at the controls. Around

twenty-five flights were completed before the jet departed for the air show. One year later, this L-139 became the first Aero jet to receive a two-tone grey tactical camouflage, which was essentially a copy of the typical F-16 paint scheme.

The jet was presented both domestically and internationally, including displays in Turkey and a demo tour across Africa down to Cape Town. The L-139 and the L-59E prototype described below used the Overberg training area in South Africa for weapons testing during the trip. Each jet logged nearly 100 flight hours and flew a total route of







Left: Front cockpit of the L-139 prototype. It was a crossbreed of the L-59E and L-39ZA.4 models, with many Western components.

Above: Rear cockpit of the L-139 prototype. It was the most modern cockpit among all Eastern jets for more than a decade.

23,760km. A partnership was formed with General Dynamics to propose the type for the JPATS competition in the USA. However, the

Left: Later picture of the same L-139 prototype as the previous page, likely the most efficient Aero jet in terms of price/performance ratio. This camouflage scheme, typical for later Aero jets, was derived from the F-16 scheme.

partner was unfortunately absorbed by the Lockheed Martin consortium, which already had a candidate for the competition - the MB-339 type from Italy. When the partnership failed, the jet was proposed to Colombia and Venezuela and was even ferried to South America for flight demonstrations. It flew for the last time in January 2000 and was

eventually demilitarised and sold to private owners in the USA. In 2015, its restoration was completed and it starred at the Oshkosh AirVenture, but it crashed several years later.

Although the L-39MS did not achieve widespread deployment with its expected main user, the USSR, it remained the most modern item in Aero's product portfolio in the early 1990s. For this reason, two L-39MS prototypes were intensively presented to foreign delegations, and the Czech Air Force, which sent the L-39MS to several international air shows, also contributed significantly to its promotion. A major success came with the signing of a contract in 1992 for the supply of fifty L-59Es to Egypt, where the L-59 designation was adopted for export variants of the L-39MS. The African customer required cockpit modifications using some Western instruments, as well as the ability to carry both Eastern and Western munitions. A modified prototype of the L-39MS, No. 0101 (with fuselage code 184 and registration OK-184 during testing), was used for trials and became the benchmark for L-59E production.

However, even with this customer, the L-59 did not enjoy long service, as the type was plagued by various technical issues during initial deployment and later suffered from a lack of interest. Another foreign user of the L-59, in the T version, was Tunisia, which acquired a total of twelve aircraft between 1995 and 1996 under the local name Fennec.

Above left: When the L-139 prototype was sold to a private operator in the US, it was stored for a few years. In 2015 it starred at the Oshkosh Air Show, owned by US pilot Diana Stranger.

Left: The L-39CW demonstrator of the L-39NG model. Note the wingtip tanks were deleted – a feature used only to distinguish the aircraft from other L-39s.



Right: US-style cockpit of the L-139 prototype when already operated in the US. Note the coffee cup holder in the right panel.

Below right: The L-39CW demonstrator cockpit. While the left IDU-680 large panel and HUD were tested, the Garmin panel was retained as a back-up.

L-59E No. 0101 was used to test specific equipment required by the customer, such as the OBOGS onboard oxygen generator and a full set of Western weapons. With the delivery of the final L-59T, development of the L-39MS/59 series was effectively concluded, as was the case with the DV-2 engine, including the planned DV-2A.2 version with increased thrust of up to 24.5kN.

For completeness, it should be noted that aircraft 0101 remains at the manufacturer's site and was used to test modernised VS-2 and VS-20 series ejection seats. During the development of the subsequent L-159 model, its sister ship 0102 was used for autopilot testing and, after retirement, served as a simulator for firefighters before being placed on display at Aero's entrance, where it remains to this day.

For both the L-59T and L-59E, TL-59T and TL-59E simulators were created by Letov Company. These differed from the TL-39MS mainly through the use of the more powerful ADT 4700 computer and cockpit instrumentation matching the real 'Westernised' jets, supplied by original manufacturers such as Bendix King. A new ejection-training simulator, the NKTL-39-59, was also produced, usable for both the L-39MS and the original L-39. Egypt acquired the NKTL-29-59 version of the simulator, which could also be used for training ejection from the L-29 aircraft operated in the country, while Tunisia acquired the single-purpose NKTL-59. In total, four flying prototypes of the L-39MS/59 and seventy serial aircraft were produced.

The knowledge gained from the L-39MS and L-139 types, particularly in the area of Western avionics and weapons, later formed the backbone for the most sophisticated aircraft Aero ever built - the L-159 ALCA. The name is an acronym for Advanced Light Combat Aircraft, which also resembles the name of the Alca bird species. Curiously, the bird is not known for its flying prowess.

The aircraft was designed as an interim solution for the newly independent Czech Air Force, enabling it to phase out Soviet-origin jets such as the reconnaissance MiG-21R, attack Su-25K, and fighter-bomber Su-24M4. As it is not a jet trainer and due to the extent of its modifications, it should be considered a separate type and will be introduced only briefly. The aircraft was designed as a single-seater with cockpit armour and an Italian Grifo-L radar in the nose. Additional features included onboard oxygen and neutral gas generation systems, radar-warning receivers with flare dispensers, and a fully digital cockpit with HOTAS philosophy implemented.

The wing was redesigned to accommodate seven hardpoints for Western munitions, with the exception of the PL-20 Czech-made, purpose-designed 20 mm twin-barrel machine gun pod. Other munitions included CRV-7 70 mm rockets, Mk.81 and Mk.82 free-fall bombs with GBU laser-guidance kits, CBU-87 cluster bomb





Above: Later paint scheme of the L-39CW. Without stencils referring to the Williams engine, the jet resembles a standard L-39.

dispensers, AGM-65 Maverick anti-tank missiles, and AIM-9 Sidewinder missiles for self-defence. The significant increase in jet weight necessitated a new engine, and the F124-GA-100 from ITEC - a consortium now part of Honeywell - was selected. This engine

dramatically improved performance, making the jet the first in its family to be limited by aerodynamic design rather than thrust.

The first prototype, used for systems testing, was a twin-seater with fuselage number 5831 and was first flown by Miroslav

Schützner on 2nd August 1997. The following aircraft, 5832, was a single-seater in standard configuration and was flown by the same pilot on 18th August the following year. Both jets were used for development and certification flights and attracted significant attention as the only low-class fighter with high-end capabilities and precision weapon delivery.

A total of seventy-two jets were ordered by the Czech Air Force, with the first aircraft, serial number 6001, flying for the first time on 20th September 1999. The final aircraft was handed over in February 2004, and the fleet was initially assigned to squadrons at Čáslav and Náměšť nad Oslavou air bases, where simulators were also delivered. However, since the country joined NATO in 1999 - a decade earlier than originally expected - defence policy changed dramatically. The L-159 fleet was soon halved, with around three dozen jets grounded and offered for sale, while the remainder continued to operate from Čáslav.

The single-seat L-159, sometimes referred to as the L-159A, enabled the Czech Air Force to retire its Russian jets, except for the MiG-21s, which remained in service until the leased supersonic JAS-39s arrived. The original L-159 model underwent heavy maintenance in the late 2000s, receiving upgraded avionics, new radios, and other enhancements. A decade later, further maintenance included modifications for NVG compatibility.

Because the original concept assumed the L-39MS would be used for training, no

Above left: The L-159 first prototype during live firing tests at the Andøya test centre in Norway. All stores were fired there over vast unpopulated areas.

Left: The L-159 prototype number 5831 during rollout with various weapon stores in front of it. The jet was designed to carry even AGM-65 Maverick missiles, although they were fired only during tests.



Right: Late paint scheme of the L-159 prototype, finished in twin-seat configuration for testing and training purposes.

Below right: The very first L-39NG prototype during its maiden flight. The primer-painted parts were changed shortly before the flight, so they lack the final paint designed by the author of this book.

dedicated training model of the L-159 was initially built. This proved to be a mistake, as the L-159's Western avionics differed significantly from the original L-39 concept - especially after the L-39MS was phased out - and Aero lacked a modern product to offer its traditional customers seeking a replacement for the L-39. This led to the development of a special double-seater L-159B model, dubbed Albatros II, which was flown on 1st July 2002. This aircraft bore the fuselage code 6073, following the last L-159, 6072. It was heavily marketed by the OEM in the new millennium but attracted virtually no interest, as did its single-seat counterpart.

After all, Aero was renowned for inexpensive and easy-to-operate training jets, while the L-159 family was comparable to fighters and lacked appeal in the traditional training market. The Czech Air Force eventually decided to purchase the double-seater and ordered the L-159T1 model, built from two donor single-seat aircraft from active inventory and storage. The first jet was flown on 8th March 2007 by Rostislav Stroin and Vladimír Kvarda. A total of four were ordered, with two more following later.

As a budget option, the L-159T1 featured low-cost avionics based on the L-159A concept, split between both cockpits, with many systems such as radar omitted. The final configuration, called L-159T2 (for which the L-159B was converted as a test aircraft and

Below: The L-159B double-seater prototype with air-to-air refuelling probe - a feature with unfinished design. Note the Smokewinder smoke generator under the wing.



designated L-159T2X prototype), included the full weapon capabilities of its single-seat predecessor. In total, five aircraft were converted from L-159T1 to this standard, known as L-159T1+, and three were newly

built as L-159T2, all introduced into the Czech Air Force inventory.

The stored L-159As were kept in protective aluminium cocoons after withdrawal and, after a decade, were sold to



the US company Draken International, which acts as a 'Red Air' aggressor for the USAF and US Navy, and to the Iraqi Air Force, which also purchased three L-159A and one L-159T1 from active inventory. In the past ten years, several new concepts such as the L-169 AJT (Advanced Jet Trainer) and F/A-259 Striker have been revealed, but none progressed beyond the marketing stage.

The very last member of the L-39 family is the L-39NG (Next Generation) model, intended as a replacement for the legacy L-39s approaching the end of their service life with operators worldwide. This project was developed by Jaromír Lang, serving as chief designer. Due to the anticipated lengthy development and limited production capacity, a two-stage project was proposed. The first stage involved addressing obsolescence issues in legacy jets, with the potential to incorporate new avionics supplied by Genesys Aerosystems, SPEEL, and Borsight, along with the brand-new Williams International FJ44-4M engine. This step was intended to extend the service life and maintain the supportability of existing aircraft until brand-new units became available. The second stage comprised a completely new airframe of refined shape, equipped with modern systems such as Martin-Baker Mk-16 ejection seats and an onboard oxygen generation system, while reusing the engine and avionics from the first stage.

Stage-one components were tested on a company prototype named L-39CW (converted from the company demonstrator L-39CA), which first flew with the new engine and avionics on 14th September 2015, piloted by Miroslav Schützner and Vladimír Kvarda. The stage-two representative, prototype serial number 0475, was rolled out

Below: Front cockpit of the L-39NG first prototype. A dramatic change from the original L-39 standard.



on 12th October 2018 and flew for the first time on 22nd December, piloted by David Jahoda and Vladimír Továrěk, followed by a second prototype a year later.

As with the L-159, this is a brand-new aircraft in many respects, although it still resembles the Albatros design and is therefore mentioned only briefly for completeness.

L-39, L-59, L-139 and L-159 flight prototypes

OK-32 OK-180 3902	First flight prototype, initially flown on 4th November 1968, now at Prague Kbely aviation museum in original scheme (previously exhibited erroneously as OK-182)
P-03 OK-23 OK-182 503	Second flight prototype, initially flown on 4th May 1969. Used for canopy release and seat ejection tests. After grounding it was used for cannon integration tests.
OK-25 OK-184 3905 OK-008	Third flight prototype, initially flown on 23rd September 1969. Now at Prague Kbely aviation museum in original scheme.
OK-186 3906 OK-184	Fourth flight prototype, initially flown on 28th April 1970, later used for DV-2 engine tests for L-39MS programme.
3907 OK-184 07	Fifth flight prototype, initially flown on 15th December 1970, destined for tests with the Soviet Air Force (marked as 'red 07'). After grounding used for canopy release tests.
3908	L-39V prototype, initially flown on 8th November 1972.
3909 OK-186	L-39ZO and later L-39ZA prototype, initially flown on 25th June 1975. Destroyed during emergency landing after one of the tests for the L-39MS program
OK-188	L-39ZA second prototype, initially flown on 29th of March 1976.
OK-HXA 3911 79 OK-190	L-39ZA third prototype, initially flown on 16th May 1977. Destined for tests with the Soviet Air Force (marked as 'red 79').
186	Serial L-39ZA (s/n 533 216) intended for L-39ZA.4 standard testing (for Nigeria).
5240	Serial L-39ZA.7 (s/n 135 240) intended for L-39ZA/ART standard testing (for Thailand).
OK-184	First L-39MS prototype, initially flown on 30th September 1983 (still with AI-25TL engine).
OK-180 0022	Second L-39MS prototype L-39MS, initially flown on 30th September 1986.
OK-182	Third 39MS prototype, initially flown on 26th July 1987. Destroyed during accident on 11th September 1992.
OK-186 0025	Fourth L-39MS prototype, initially flown on 6th October 1987.
0101	Originally first serial L-39MS, converted to L-39E and later L-59T prototype.
5501	First L-139 prototype, initially flown on 8th May 1993.
5831	First L-159 prototype (dual seater), initially flown on 2nd August 1997, at Prague Kbely aviation museum.
5832	Second L-159 prototype (single seater), initially flown on 18th August 1998.
6073	First L-159B prototype, initially flown on 1st July 2002. Rebuilt to L-159T2X variant.
2626	L-39NG Technological Demonstrator, initially flown on 14th September 2015.
0475	First L-39NG prototype, initially flown on 22nd December 2018.
0476	Second L-39NG prototype, initially flown on 9th December 2019.



AFTERMARKET CONVERSIONS

After the break-up of the USSR, ties between the Russian Air Force and the OEM loosened to such an extent that the Russian Myasishchev Design Bureau was appointed as the local OEM substitute for the Russian Air Force. Its experts conducted full-scale fatigue tests on several L-39s to verify the remaining service life of the fleet. The bureau assigned a service life of 6,000 hours, with the possibility of extending it up to 10,000 hours.

Myasishchev also managed the local Russian L-39-97 upgrade project, intended as a gap-filler following the cancellation of plans for the L-39MS, until a new trainer - either the MiG AT or Yak-130 - became available.

The aircraft received new avionics, including a HUD display and mission computer with digitised output in the form of a flight data recorder for post-flight debriefing. Structural reinforcement of the wings was intended to allow four hardpoints with a total weapon load of 1,500kg (all

Above: The Russian L-39C.1, modified by the Myasishchev bureau with new avionics and Russian-origin parts. Although heavily promoted, it never became a Russian standard.

Soviet L-39Cs were equipped with only two hardpoints). Many Czech components were replaced with Russian equivalents, including the installation of the Zvezda K-93L-19 lightweight ejection seat with zero-zero parameters. Only one prototype was completed in 1999, named L-39MT. Some plans even envisioned the type being used in light combat operations, as experience from post-USSR border clashes revealed some potential. The weapon array was to be extended to include 9M114 Shturm anti-tank missiles and a FLIR gimbal for target localisation. However, a lack of funding for non-Russian types meant that the prototype was not flown until 2004 and was ultimately not accepted by the air force. Only certain Russian components were selected as mandatory upgrades during overhauls of Russian L-39s.

In 2020, the United Aircraft Corporation (OAK) revealed another L-39 upgrade, again led by the Myasishchev Bureau. This time, the aircraft featured fully Russian avionics and a new experimental paint scheme for open storage. Further aircraft were scheduled to be upgraded during overhauls.

The Ukrainian Air Force became the largest surplus market for L-39s in the world. Dating back to the Soviet era, two independent overhaul facilities were located in Ukraine. The first, named Odesaviaremservice and based in Odessa, introduced its upgrade project in the late 1990s: the L-39U (Uluchshennyi – Improved) for domestic use and the L-39AUP (Avionics Upgrade Programme) for foreign customers. It was a joint project between Odesaviaremservice, AI-25TL engine OEM Motor Sich, and Israeli company IAI. One serial L-39, s/n 332 601, was selected for the upgrade, during which it received brand-new avionics including MFD



Above left: Recent L-39C.1 modernised by the Myasishchev bureau with new paint designed for open storage. The jet features Russian avionics.

Left: The L-39U, a downgraded derivative of the L-39U project. The Ukrainian Air Force became the sole operator of the type.



and HUD displays, a digital flight data recorder, mission air data computer, GPS navigation, and a TAWS terrain warning system. The aircraft flew for the first time on 30th August 2002 and was later displayed at a local show in Kyiv. The static display included UB-16-57U blocks for 57 mm unguided rockets and a conformal pod with an A-12.7

gun pod - a brand-new feature for the type. As an option, the aircraft was proposed to be equipped with the upgraded and more powerful AI-25TLSh engine. However, the type never gained traction, despite being shown internationally at the Paris Air Show in 2003.

Only in 2005 did the Ukrainian Air Force request a less extensive upgrade project called

Above left: Cockpit of the L-39C.1 modified by the Myasishchev bureau. Note the large HUD display without a UFCP panel, as was standard in Russian jets.

Above right: Modernised cockpit of the L-39M model with HUD and MFD displays, as well as new indicators such as the combined AoA and g-meter.

L-39M, staged in M1 to M3 standards. The M1 standard included the new Ukrainian-made AI-25TLSh fit-and-form engine, a digital flight data recorder, and a slight cockpit upgrade with one MFD on each instrument panel and a HUD in the front cockpit. The control grips were replaced with new models mimicking MiG-29 and Su-27 sticks. The weapon range, originally consisting of UB-16-57U rocket pods and free-fall bombs up to 100 kg, was extended to include UPK-23-250 twin-barrel 23mm cannons and even R-60 IR-guided missiles

Left: The civilian L-39D aircraft. Ukrainian overhaul companies performed subsequent jet overhauls, although they obtained documentation only for the first scheduled overhaul.

Below: Civilian L-39C.1 operated by the Russian Radar MMS company for testing various avionics and other military systems.



Right: The most visible operator of the Albatros and an excellent ambassador for the type – the Breitling Jet Team. It operated up to twelve L-39C.1s under the parent company, with seven jets used for display and eight acting as back-up.

Below right: US-origin L-39X prototype – a standard L-39C.1 equipped with the TFE731 engine tested on the L-139. The rebuild was done in the USA with zero support from the OEM.

(this variant did not require seeker cooling). The subsequent M2 and M3 variants further extended the avionics upgrade to a level close to the L-39U scope. The first prototype was test flown on 14th November 2009, and in 2011 the Ukrainian Air Force adopted the first two serial aircraft. More aircraft were upgraded, but most retained the standard TL engine for budgetary reasons.

The second Ukrainian overhaul plant, CHARZ, based in Chuhuiv, introduced in 2010 a demilitarised L-39D (Demilitarizovannyi – Demilitarised) model intended primarily for hobby operators in the USA. It lacked all military systems and its avionics was upgraded with commercially available Garmin products. The first prototype, converted from serial L-39C (s/n 530 530), was flown in November 2010 as UR-CGH. A similar project, named L-39G (Grazhdanskyi – Civilian), was also undertaken by Odesaviaremservice. For example, L-39 jets operated by the Breitling Jet Team and Baltic Bees Jet Team were downgraded in Odessa.

Another major upgrade, called L-39CM or L-39ZAM depending on the entry model, was introduced by the Slovak LOTN Trenčín overhaul plant for the Slovak Air Force. The original Eastern-style avionics was replaced with Western navigation systems of VOR/ILS/MB/DME standard, TACAN radios, new transponders, backup instruments, and an emergency location transmitter. The first upgraded aircraft was an L-39C with fuselage code 0111, and it became the first Slovak military jet compliant with NATO avionics standards. While new airframes from OEM stock were

Below: OA-39, a technology demonstrator operated by Borsight company. Note the EO/IR gimbal in the nose. The jet featured very advanced avionics mimicking combat jets.



used for the L-39CMs - resulting in new serial numbers - the L-39ZAM was a pure upgrade of legacy aircraft with the original airframe retained. In a similar fashion, Czech L-39Cs were also upgraded with GPS-aided navigation in several stages, although no specific designation was assigned to the modified model.

Arguably the most comprehensive L-39 avionics upgrade was carried out under the L-39SIA model, with the abbreviation

standing for Slovakia, Israel, and Angola. Four Angolan L-39s were upgraded by Slovak LOTN with assistance from Israeli company Elbit to a standard where each cockpit featured large 6x8 MFDs of Israeli origin, a HUD display with UFCP panel in the front cockpit, and a UFCP panel in the rear. The upgrade also included new radios and navigation aids. The mission computer generated aiming curves on the HUD display. Angolan Su-22M4 fighter-bombers



Right: The L-39 ACE demonstrator operated by ITPS Canada. It is the very first L-39 family member with a fly-by-wire (FBW) control system.

were upgraded in the same way. Although never officially endorsed by the OEM, it became a very interesting and relatively low-cost upgrade, significantly enhancing the aircraft's efficiency in both training and live mission deployment.

A wide range of modifications appeared in the USA on ex-military jets operated mostly by private owners. Some upgrades, such as recalibration of metric instruments to imperial units and replacement of Eastern-style navigation with Western equivalents, were obvious. Many L-39s received glass cockpits, although some systems proved unreliable during high-g manoeuvres, often displaying 'inoperative' warnings on the screens. Most owners opted to remove pyrotechnics from the seats, as live seats were costly and logistically difficult to maintain. A number of jets were fitted with simple autopilot systems to maintain course, or even in-flight entertainment systems for the crew. Operators keen to demonstrate their jets often requested smoke-generating systems, sometimes coupled with high-intensity LED lights aimed behind the jet. At night, the effect of smoke illuminated by LED light closely resembled afterburner reheat.

Some modifications, such as composite wing tips, proved problematic, as not all



designs performed equally in standard and inverted flight. Over time, some concepts demonstrated that wingtip tanks were unnecessary for hobby flights, as the extra fuel was offset by increased drag.

Far more extensive upgrades resulted in the L-39X and L-39 ACE models. The former used the TFE 731 engine retrofitted to the L-39 airframe. The upgrade mimicked the OEM L-139 model and offered many advantages. The engine provided slightly higher thrust, much better spool-up time, lower fuel consumption, and easier maintenance in the US, with several service centres nationwide.

Installation allowed for complete removal of the heavy APU, as the new engine used electrical starting. Unfortunately, the modification did not account for the engine's intense acoustic vibrations, which were compensated for in the OEM-standard L-139 by a composite air duct - a feature not available for legacy jets. Very few aircraft have been upgraded to date, using engines sourced from Learjet models.

The L-39 ACE, a model introduced by the International Test Pilots School (ITPS) Canada, featured a fly-by-wire control system and a large-area panoramic display in the front cockpit. It proved to be the most advanced modification of the Albatros to date, in contrast to many US-based upgrades, which - although professionally executed - placed greater emphasis on safety than on technological advancement.

The front cockpit is entirely free of mechanical instruments, instead equipped with a large-area MFD, HUD, a back-up Garmin combined navigation/communication system, and sidesticks featuring HOTAS controls only. The rear cabin retains redundant manual controls for safety purposes. As ITPS plans to use the aircraft for test pilot training, a specialised flight parameter monitoring system was developed, enabling easy in-flight reading of dozens of values on the MFD. Both the HUD and the control laws for the fly-by-wire system were developed in-house by ITPS.

Additionally, the US company Borsight upgraded one of its L-39s to the OA-39 model under the ATLAS project (Advanced Training Light Attack System). This version featured brand-new avionics, a surveillance system, and enhanced weapon capabilities. It was designed as a platform with a fully integrated digital cockpit, based on a HUD and two large MFDs, allowing the pilot to perform navigation, tactical, sensor, and weapon procedures similar to those in high-end fighter aircraft. The onboard avionics could even simulate virtual radar, missile warning systems, and threat environments. Borsight later became a supplier of the Up Front Control Panel for the L-39NG.

Above left: The OA-39 instrument panel with two IDU-680 displays and UFCP, also used in the L-39NG model.

Left: The L-39 ACE front cockpit with large-area display and side sticks of the FBW control system. Definitely the most modern cockpit of the L-39, exceeding even the L-39NG.





WORLDWIDE FOOTPRINT

The L-39's very first export customer was, unsurprisingly, the Soviet Air Force, which received its initial aircraft in 1973. By 1989, Aero had delivered the type to twelve additional foreign operators, with the Iraqi Air Force being the first in 1975. Following the Velvet Revolution in Czechoslovakia, the OEM delivered further jets to expand Algeria's existing fleet and established new connections with countries such as Bangladesh, Ethiopia, Lithuania, and Yemen. In these cases, jets originally produced for the USSR or Nigeria - but never delivered - were repurposed.

The final customers for newly produced aircraft were Thailand for the L-39 and Egypt and Tunisia for the L-59. Due to the large number of surplus L-39s in post-Soviet republics, Ukraine and Kyrgyzstan became the largest re-exporters of the type. With the support of Ukrainian overhaul plants and recent deliveries of surplus L-39s from Russia to Mali and the Central African Republic, the number of states that have operated the type historically reached forty-seven. Notably, the aircraft was also operated by four internationally unrecognised entities, including separatist republics in the former USSR and ISIS in the Middle East. All military operators are

detailed in separate entries below.

The L-39 also became highly popular with private operators shortly after jets became available following the fall of the Iron Curtain. As early as 1989, US enthusiasts visited the OEM, and Czechoslovak emigrants helped deliver the first jets to the USA. In total, no fewer than 350 aircraft were imported into the USA, and further deliveries were made to Canada, Australia, New Zealand, South Africa, and numerous European countries. The aircraft's excellent flying qualities enabled the formation of several private jet teams. The first, in the mid-1990s, was the US-origin Jet Team, followed by Northern Lights Jet Team, Patriots Jet Team, Heavy Metal Jet Team (later renamed Black Diamond), Hoppers, Red Steel, and Czech-Mate Jet Team.

In Russia, jets were used by the private team Russ of Vyazma, a former DOSAAF (Dobrovol'noe Obshchestvo Sodeystviya Armii, Aviatsii i Flotu) aeroclub privatised in the 1990s. Further teams emerged in Europe, including the Breitling Jet Team from France, Baltic Bees from Latvia, Sparflex from France, Art on Air from Germany, and the latest, Blue Eagles from Italy. The Breitling Jet Team, arguably the most visible L-39 team ever, completed two world tours - one in Asia and another across the USA. Even the OEM operated its own team in the late 1980s and

Above: Afghani L-39C.4 shortly after delivery, with original roundels used until the revolution. The picture was taken following the delivery ferry flight.

early 1990s, called Aerotrio - the only manufacturer's team to fly various customers' jets prior to delivery.

It is worth noting that L-39s are still used in the USA by the Polaris Jet Team, formed by Jared Isaacman, and by the Russian organisation Roscosmos, both utilising the jets for astronaut training. The civil L-39 fleet has also become a staple in aviation-themed films, starring in the Bond film *Tomorrow Never Dies* and used for aerial photography in *Top Gun: Maverick*. The aircraft's flight qualities and ease of maintenance have led to its use by US 'Red Air' aggressors such as Air USA, ATAC, Lortie Aviation, Northern Lights Combat Air, and Draken International, as well as Skyline in the Netherlands and Apache Aviation in France. Quite literally, there is hardly an aviation task the L-39 has not performed.

Abkhazia

Abkhazia, formally part of Georgia following the USSR's dissolution, declared independence in summer 1992, prompting Georgian military intervention. During the yearlong conflict, Chechen mercenaries supported Abkhazia, and Chechnya even supplied L-39C.1 aircraft. These were deployed in combat, attacking government forces with unguided rockets and 50kg free-fall bombs. One aircraft was credited with shooting down a Georgian drone. The jets retained Soviet insignia, and two were upgraded to carry R-60 infrared-guided missiles. In 1999, two additional L-39C.1s were delivered from Russia. A total of five aircraft were later documented at Sukhumi Airbase.

Afghanistan

Afghanistan received twelve L-39C.4 aircraft in 1976. Between 23rd September and 2nd October, Czechoslovak military crews ferried the aircraft, accompanied by an An-24 support plane, over a 5,042 km route to Mazar-e-Sharif Airport. All aircraft were assigned to



Left: Early L-39C.4 with original Afghan roundels used between 1978 and 1980. Note the flight crew wore leather helmets despite the risk of ejecting through the canopy in case of release failure.

the 393rd Training Regiment, organised according to Soviet military structure. Afghan Air Force instructors received training and type ratings in the USSR at Primorsko-Akhtarsk Air Force Base in spring 1977. Due to repeated defections, the limited number of Afghan instructors was supplemented by Soviet personnel of Uzbek and Turkmen nationality.

Afghan pilots began jet training on the L-39 before progressing to MiG-17s and ultimately MiG-21s. The first locally trained crew completed training in August 1979. Following the 1979 revolution, the regiment took on additional combat roles. L-39s equipped with S-5 unguided rockets and FAB-100 bombs attacked rebel positions, although combat sorties were flown exclusively by Soviet crews. One common task was reconnaissance of Kabul Airport's surroundings. With increasing training and surveillance missions, a new batch of six L-39C.4s was delivered in 1982, although one was lost during a reconnaissance sortie. In 1984, a final batch of eight L-39C.1s - originally intended for the Soviet Air Force - was delivered. By the mid-1980s, Afghan pilots had begun assuming instructor roles. This led to two defections to the Mujahideen and two more to Uzbekistan. In response, the regiment was placed under Uzbek military district command, with strict oversight of Afghan-only flight crews. Combat operations intensified, and two more aircraft were lost to enemy fire. As of 1988, at least eight aircraft remained operational. Notably, one L-39 graduate was Abdul Ahad Momand, who became Afghanistan's first astronaut, flying aboard Soyuz TM-6 to the Mir space station in 1988. Two female pilots were also trained in the late 1980s - an achievement not seen under the later Taliban regime.

In the 1990s, the country fractured politically. The Taliban captured



approximately five aircraft, while the Northern Coalition retained ten, of which only four or five were operational. Both sides attempted to use the L-39s in combat, with limited success. In 1999, two Northern Coalition aircraft fled to Tajikistan and landed at Kulob Airport. In 1992, one Taliban-controlled aircraft defected to Uzbekistan, which seized and continued operating it. Following the launch of Operation Enduring Freedom in 2001, five L-39s were spotted at Sheberghan Airport. These underwent overhauls by Russian and Ukrainian firms and were restored to airworthy condition. They were prominently featured during the May 2007 national day parade flyover in Kabul. However, in August 2008, all aircraft were grounded due to serious malfunctions stemming from improper overhauls. They remained parked at Kabul Airport.

The Taliban captured at least two long-term stored L-39C.1s at Kabul Airport. One jet underwent an engine run in December 2021, operated by a Taliban pilot and mechanic. It is unlikely the aircraft will fly again after a decade of storage, although one was seen taxiing in 2023.

618th Advanced Training Squadron at Tafraoui Airbase near Oran, which also received TL-39 simulators. The L-39 followed the Czechoslovak Zlin Z-142 piston aircraft in the training syllabus. In 1990, a further twelve jets were ordered, and the OEM offered discounted, unfinished Soviet L-39C.1s. Seven were ordered as an additional batch for elementary training. All were assigned to the same unit, with some later transferred to the 620th Training Squadron at Mécheria Airbase in the Atlas Mountains. A local demonstration team, Noumor, flying tiger-themed L-39s, was based there and comprised unit instructors. Although forma

Algeria

Algeria received its first L-39ZA.1s in 1987 to replace obsolete MiG-15UTIs, with twenty aircraft ordered. These were assigned to the



Right: Angolan L-39C.1 in a configuration upgraded by Slovak and Israeli companies, as evident from the HUD display in the front cockpit.

Below right: Detail of the Angolan L-39C.1 cockpit with HUD and MFDs, both added during overhaul by Slovak and Israeli firms.

Angola

Angola did not receive any L-39s directly from the OEM. Instead, in 1997, it acquired two surplus L-39Cs from an undisclosed European country - allegedly Belarus - via an Israeli company. The aircraft were used for training MiG-21 and MiG-23 pilots and for surveillance missions along the border with Zaire (now the Democratic Republic of Congo). Reconnaissance missions included fast flyovers of the border zone. Although armed with unguided rockets, the jet's noise was often its most effective weapon, as spotting enemies in the dense rainforest proved nearly impossible. A year later, one additional L-39ZO was donated by Libya. All aircraft were grounded within a few years due to poor maintenance. In 2006, one of the jets was refurbished in Slovakia, along with two ex-Slovak L-39C.1s, as part of a larger deal that also included the delivery of ex-Slovak Su-22M4 and Su-22UM3K aircraft, as well as ten L-29s. The L-39s underwent extensive avionics upgrades, including the integration of MFDs on each instrument panel and a HUD display in the front cockpit, both supplied by Israeli companies. The upgrade was designed to facilitate an easy transition from the turboprop EMB-312 trainers already in use.

All training aircraft were assigned to the Escola Militar de Formação Aeronáutica at Catumbela Airport. Between 2008 and 2009, some Angolan L-39s underwent general overhaul in Ukraine. In 2023, Aero signed a deal to upgrade four L-39s, though progress remains unclear.

Armenia

Armenia inherited a limited number of aircraft from the USSR, mostly transport planes and helicopters, as only two independent helicopter regiments had been stationed in the country prior to 1991. During the Nagorno-Karabakh War, Armenia lacked fixed-wing aircraft until a few MiG-25s and Su-25s defected from Azerbaijan and Georgia. However, the MiG-25s were neither supportable nor practical post-war, and the Su-25 was shot down in 1993. Consequently,



Armenia signed an agreement with Russia for airspace protection. Two L-39C.1 aircraft were delivered from Russian surplus in 1995 and assigned to the 121st Combat Aviation Squadron at Gyumri Airbase near the Georgian border. In 2003, Armenia signed multiple agreements for jet deliveries - Su-25K and Su-25UBK from Slovakia, and L-39C.1s from Ukraine. All L-39s were assigned to the 121st Squadron and the Yerevan-based High Technical School, which

served as a training academy.

Young pilots began their careers on outdated Yak-52 and Yak-55 piston trainers, progressing through the L-29 to the L-39. In 2011, Armenia acquired six more L-39C.1s from Ukraine. Curiously, at least two of these aircraft were delivered in the colour scheme of the Estonian Baltic Bees Jet Team. These jets had been overhauled in Ukraine for the team but were rejected for technical reasons, so the maintenance plant sold them to Armenia without repainting.



Azerbaijan

Azerbaijan seized a total of fifteen L-39C.1s located on its territory, originally subordinated to several ex-Soviet units, along with dozens of L-29s. All training aircraft were concentrated at Kyurdamir Airbase, although only four L-39s were operational due to a lack of spare parts. The aircraft were used for training Su-25 pilots and for recurrent training. During the war with neighbouring Armenia, L-39s were deployed in combat, armed with S-5 unguided rockets and FAB-50 or FAB-100 free-fall bombs. Armenian forces, although lacking air support, were well equipped with anti-aircraft systems and

Left: Armenian L-39C.1 freshly overhauled in Ukraine. The jets had a short service life in the country.

Right: Azerbaijani L-39C.1 at a local base. Delivered from Ukrainian surplus after overhaul, it retained a Soviet-style paint scheme.

Below right: Bangladeshi L-39ZA.9 jet during pre-flight maintenance. Note the 'No L-39 ZA AC Beyond This Point' warning sign on the ceiling.

managed to shoot down several Azerbaijani aircraft, including one L-39 in 1992 during a reconnaissance sortie. Following this loss, L-39s were withdrawn from frontline operations.

In 1993 and 1994, further aircraft were reactivated, but within two to three years, all were grounded due to technical issues. In 1998, twelve L-39C.1s were delivered from Ukraine, all sourced from surplus stocks and overhauled prior to delivery. Since 2012, only half of the fleet has remained operational, with the rest used for spares or placed in storage. Yak-52 piston trainers are used for elementary training, followed by progression to the L-39. The type is used to train pilots for MiG-29UB, Su-25UB, and Su-25UBK aircraft.

Bangladesh

In the late 1980s, Bangladesh was still operating the Cessna T-37 Tweet and sought a replacement. In the early 1990s, the Czech L-39ZA was selected as the ideal candidate, and eight L-39ZA.9 aircraft were delivered in 1995. All airframes originated from unfulfilled Nigerian orders but were modified to the ZA.9 standard prior to delivery. The aircraft featured slightly different avionics and VS-2 ejection seats with zero-zero parameters, derived from the L-39MS model. All aircraft were assigned to the 25th Training Squadron 'Trendsetters' at Chittagong – Zahurul-Haque Airbase. The jets were used for both pilot training and border patrol missions. Graduates progressed to flying twin-seat F-7s and later MiG-29s. Training regularly included live firing exercises at the Kutubdia firing range near the base.

After nearly eight years of operation, two jets were refurbished by the OEM in the



Czech Republic. Additional aircraft were overhauled in Romania by a non-authorized company and supplemented by three surplus L-39ZA.1s. Interestingly, the jets were also assigned civil registrations S3-ANA to S3-ANH.

In the new millennium, the number of operational jets declined rapidly. One aircraft was damaged beyond repair after skidding off

the runway in rainy conditions, another was lost due to unresolved defects from a non-authorized overhaul, and several others were cannibalised for spares. Around 2020, the final L-39 flight occurred as the Yak-130 was introduced into the training syllabus, leading to the gradual phase-out of the Albatros. One aircraft remains as an instructional airframe for technician training, another serves as a gate guardian, and the rest are in storage.



Belarus

Belarus inherited only six L-39s from the USSR, as no air force training units had been stationed on its territory. Many units relocated to Russia, leaving only six L-39s in Belarus, of which just half were operational. As a result, the L-39 was not formally adopted into the Belarusian Air Force, and crews were sent to Russia for training.

In 2004, the Belarusian Ministry of Defence signed an agreement with Ukraine for the delivery of ten surplus L-39s, refurbished by Ukrainian plants. A group of technicians was sent to Russia for maintenance training. In 2005, four L-39C.1s were handed over, followed by the remaining six a year later. All jets were assigned to the 206th Airbase of Combat Aviation near the city of Lida, where they operated alongside Su-25s and Su-25UBs.

Pilots transitioned to the L-39 after graduating from the piston-powered Yak-52, operated by the BeOSTO national aeroclub. Since 2010, the L-39s have been assigned to

Left: Belarusian L-39C.1 in the Belaya Rus jet team paint scheme. An ex-Ukrainian jet delivered post-overhaul.



Above: Bulgarian L-39ZA.1 freshly overhauled domestically by the OEM. Avionics had previously been upgraded by Israeli companies.

the newly independent 206th Centre for Training of Flight Crews. Graduates now progress to the Yak-130 before joining combat units.

In 2008, following an order from the Minister of Defence, a jet demonstration team named Belaya Rus (White Russia) was formed using operational L-39s. The aircraft received a distinctive paint scheme featuring national ornamental motifs. A total of eight jets are used, with a ninth serving as a backup. The pilots are instructors from the training unit, and the team's first public display took place at Borovaya Air Force Base in July 2009, coinciding with celebrations marking

the end of the Second World War. The first team leader was Colonel Alexandr Zimin, a former Soviet veteran pilot with combat experience in Afghanistan.

Bulgaria

Bulgaria ordered its first batch of twelve L-39ZA.1s in 1985 as a prospective replacement for legacy L-29s and MiG-15UTIs. All aircraft were assigned to the Air Force Academy named after G. Benkovski at Dolna Mitropoliya Air Force Base. In 1987, a further six were delivered, followed by a final batch of eighteen in 1990. These aircraft were assigned to the 1st and 2nd Squadrons of the

12th Training Base at Dolna Mitropoliya, although they were also temporarily operated from Shtraklyevo and Kamenets Air Force Bases.

When the L-29s were replaced by new turboprop PC-9Ms in the late 1990s, the L-39s remained in service as advanced trainers for Bulgarian MiG-21 and Su-25 pilots. Air Force restructuring in the mid-1990s led to the transfer of four L-39s to the 3rd Fighter Squadron at Graf Ignatievo Air Force Base, while the remaining aircraft were reassigned to the 12th Training Squadron at Kamenets.

After 2002, the fleet was consolidated under the 12th Training Group at Dolna Mitropoliya, subordinated to the 3rd Aviation Base at Graf Ignatievo. Although the Air Force began modernising its inventory with the PC-9M, the L-39 remained essential for training MiG and Sukhoi pilots due to its Eastern-standard systems. However, budget cuts nearly grounded the fleet in the early 2000s. Between 2005 and 2006, the OEM extended the service life of twelve aircraft - a cost-effective solution that allowed continued operation without full overhauls. Some aircraft received minor upgrades from Israeli companies during this period.

By 2010, only three aircraft remained operational. To offset costs, the Air Force sold several jets to private operators in the USA and Africa. In 2012, an agreement was reached with the OEM for refurbishment and service life extension of twelve aircraft, and in 2025 two L-39ZAs passed a general overhaul with avionics upgrades performed by Aero.

Cambodia

Cambodia never established a direct relationship with Aero but briefly operated the L-39. In 1993, the Royal Cambodian Air Force signed a deal with Israeli companies for the reactivation and upgrade of MiG-21bis and MiG-21UM fighters, along with the

Above Left: One of the Cambodian L-39C.1s during the handover ceremony in 1997. The FAB-250M-62 bomb was not cleared for L-39C.1 use; only the L-39ZA model could carry it.

Left: Stored Cambodian L-39C.1s at Phnom Penh airbase, with a Mi-26 visible behind. The jets were operated only briefly.



Right: Central African Republic received L-39C.1s from Russia. They were active inventory aircraft, neither overhauled nor repainted prior to delivery, as visible in the image.

delivery of six L-39C.1s from an undisclosed ex-USSR country. All aircraft were overhauled in Ukraine and delivered between 1995 and 1997, although one was lost in an accident shortly after arrival. All jets were assigned to the combat squadron at Phnom Penh Airbase and used for training and light combat missions against the Khmer Rouge, employing free-fall bombs and 57mm unguided rockets. Due to maintenance issues, the aircraft flew infrequently and were placed in storage before 2006, marking only a decade of operation.

Central African Republic

The Central African Republic received its first two L-39C.1s in May 2022, sourced from the active inventory of the Russian Air Force. Prior to delivery, only the Russian national insignia was provisionally repainted. The transfer was part of Russia's broader influence campaign in Africa and followed similar deliveries to Mali. One year later, a third L-39C.1 was delivered aboard a Russian Air Force Il-76 cargo aircraft. The jets are operated from Bangui Airbase, the country's sole airport. They are intended for surveillance missions, although one aircraft crashed in 2022 during a live mission, reportedly due to a technical malfunction. Moscow has announced plans to deliver six L-39C.1s in total, but no further details have been confirmed.

Chad

Chad received the L-39ZO.1 ships during combat clashes with neighbouring Libya. The war, ongoing from 1978 for nine years, was full of surprising moments. In 1984, Libya agreed with France, a strong supporter of the Chadian government, that in two years both countries would withdraw their forces from Chad. While France did pull out, Libya's 5,000 soldiers remained and even crossed the demarcation line. The L-39s were used by Libyans for reconnaissance missions and even performed live fires of unguided rockets and free-fall bombs. Following this, Paris launched an air raid on the Ouadi Doum



(sometimes referred to as Wadi Doum) airbase, where Libyan forces were stationed. The attack by French Mirage F1s and Jaguars seriously damaged the runway, preventing all aircraft including ten L-39ZOs and SF-260 piston planes from leaving the site. After Libyan forces left the airbase, seven L-39s were provisionally repaired, and later three of them passed a general overhaul at the OEM, while four were sold to the US and UK governments and eventually ended up with private operators. Until 2011, the L-39s were operated at the capital N'Djamena airbase with support from Ukrainian contractors, and later they were kept in open storage there.

Chechnya

Chechnya declared independence in 1991, recognised only by Taliban-controlled Afghanistan. Despite this, the new Chechen government under Dzhokhar Dudayev - a former Soviet Air Force Major General - initiated efforts to build its own air force. Although the USSR did not recognise Chechen independence, the chaos following its collapse allowed Chechen rebels to prevent Soviet forces from withdrawing military hardware, including sixty L-39C.1s located at Khankala Air Base, alongside a large number of L-29s.

The 382nd Training Regiment of the Soviet Air Force operated eighty-nine aircraft in total, of which nearly one-third were returned to Russia, with the remainder left in Chechnya. The Chechen Air Force formed two squadrons, although by 1992 only fifteen aircraft were airworthy. Several pilots were clandestinely sent to Turkey for military training, and mercenaries from former USSR countries were hired as staff. In 1994, Chechnya celebrated the third anniversary of its independence declaration with a fly-past over Grozny, prominently featuring L-39s. Four aircraft were donated to Abkhazia in 1992.

When negotiations between Grozny and Moscow failed and the First Chechen War erupted, L-39s were used in combat. The first was shot down by Russian forces in October 1994, likely by an Igla MANPADS missile. Despite this loss, Chechen rebels continued using L-39s to attack Russian convoys with unguided rockets and free-fall bombs. Several air-to-air engagements were documented, including two L-39s shot down by R-60-equipped Russian Su-24s. Operations ceased in late 1994 following a massive Russian bombing raid on Chechen airbases, which seriously damaged or destroyed thirty L-39s on the ground. The last documented Chechen L-39 flight occurred in March 1995.

Cuba

Cuba became the most distant L-39 operator, ordering thirty jets for basic and advanced training. Due to the L-39C.1's limited range and the inability to overfly US territory, ferry flights were not possible. Instead, the aircraft were delivered in wooden crates aboard cargo ships, wrapped in special cocoons to protect against sea salt. The first jets arrived in late 1982 and were assembled by OEM crews, who found the tropical island a rare and welcome work location. All aircraft were based at La Coloma Airbase, where two squadrons operated fourteen jets each. Two additional aircraft were deployed to San Antonio de los Baños Airbase for liaison duties and recurrent training. La Coloma was



Left: Cuban L-39C.1 on a transport platform after offloading from a merchant ship. Cuba has operated the type for decades with no OEM support.

Right: A trio of L-39ZA.4s originally produced for Nigeria, now bearing provisional (and incorrectly positioned) Czech roundels and duct tape-made fuselage numbers.

Below right: Fleet of Czechoslovak Air Force training jets during formation flight training – showing the L-39C.1s were delivered in varied paint schemes.

also equipped with a TL-39 simulator and an ejection training system. Located near the seashore, the jets regularly flew over the ocean.

Alongside the jets, Cuba established a maintenance capability at the Yuri Gagarin facility in Havana. A large stock of spare parts was ordered to ensure self-sufficiency, and no further orders were placed with the OEM after 1990. Around eight years later, La Coloma was abandoned, and the L-39s were transferred to the Mixed Fighter Squadron at San Antonio de los Baños, where Czechoslovak Z-142 piston trainers were also in use.

At the Interception Squadron at Holguín Airbase - home to MiG-21 and MiG-29 fighters - the L-39s served as advanced trainers and off-load aircraft. Ukrainian mercenaries supported operations, and general overhauls were performed locally in the mid-1990s. Twelve jets underwent service life extension, identifiable by their colourful new paint schemes. Some aircraft were fitted with a second pair of weapon racks, leading to erroneous classification as L-39ZO in Western media. Photographs exist showing L-39s armed with R-3S missiles.

One jet is used as an instructional airframe at the José Martí Instituto Técnico Militar in Havana, where a modernised TL-39 simulator is also located. Another aircraft is displayed at the Havana Aviation Museum. In 2014, the L-39s were consolidated under the 3rd Training Squadron of the Western Air Zone (Zona Aérea Oeste) at San Antonio de los Baños, with only eight aircraft remaining operational. The jets are heavily used for maritime patrols and frequently carry UB-16-57 rocket pods.

Czechoslovakia

Czechoslovakia was, for obvious reasons, the launch customer for the L-39, with the first aircraft formally handed over in 1972. The initial batch was divided between the national research institute and the Air Force College in



Košice, Slovakia, where the L-39C initially formed the core of the 2nd Training Regiment. Early operations focused on developing training methodology and syllabuses, as well as verifying OEM-prescribed procedures.

Originally, the L-39 was intended to serve as an advanced trainer following the L-29, with the long-term aim of becoming the first jet type in the training syllabus - a scheme that was operational for a period. During early service, the aircraft suffered typical teething issues. In 1974, the first loss occurred during

a night flight when the engine stalled and failed to restart. Both crew members ejected successfully, but the aircraft was completely destroyed. The fault was traced to engine design and corrected, allowing deliveries of new L-39C.1 aircraft to continue. In 1976, the L-39V model was introduced for target towing, with eight aircraft delivered - two of which were later transferred to the East German Air Force.

Within the 2nd Training Regiment, a four-ship formation team was created and performed flyovers during cadet graduation ceremonies. Tragically, one of its members became the first pilot to die in the type, crashing during aerobatic practice. Several more jets were damaged or destroyed during intensive training operations, prompting the delivery of additional small batches of L-39Cs in the 1980s, along with simulators. A notable incident occurred in August 1988 when an L-39C.1 experienced engine failure and could not be restarted. The crew opted for an emergency landing. One pilot ejected, while the other remained in the aircraft, which slid into a grass strip next to the runway. Despite heavy damage, the second pilot emerged uninjured, while the ejected crew member was safely recovered.

As the fleet grew, six aircraft were detached to the 3rd Training Regiment at Piešťany Airbase. In 1990, the core of the



Left: Czechoslovak L-39C.1 in the mid-1970s at Košice Air Force Base, where most training regiments were located.



Above: Košice base operated dozens of L-39s. Pictured is another training day with at least five Czechoslovak jets ready for take-off, and likely more already airborne.

future Slovak national display team, Biele Albatrosy (White Albatrosses), was formed in Košice. Their first display took place on 3 August 1991 at Boľkovce Airfield near Lučenec, during a parachuting championship. By 1992, the team operated five aircraft and performed at the CSIAF Air Fest in Bratislava, gaining significant popularity before the federation split.

In the late 1970s, the Air Force decided to procure the armed L-39ZA model to replace obsolete MiG-15bis SB jets. In 1980, the Air Force College received the first five aircraft. After crew familiarisation, further jets were assigned to the 30th Fighter Bomber Regiment at Hradec Králové Airbase, where

they were used for border zone interceptions - primarily against unarmed civilian aircraft that had lost navigation.

Many missions involved intercepting German, Austrian, and US Army helicopters, which were too slow for MiG-21s and MiG-23s to engage effectively. The L-39ZA was expected to take over slow-speed interception duties but proved unsuitable due to limitations of the GSh-23 cannon, which was affected by angle of attack and risk of engine surge during aggressive manoeuvres. Mi-24 attack helicopters were eventually preferred for the role, especially the 'hot and high' Mi-24V variant.

Some L-39ZAs were equipped with R-60

infrared-guided missiles, giving the aircraft high-g turn capability and making it a credible threat - the Albatros got its claws. A documented intercept in 1985 involved a US Army AH-1F, with unguided rockets fired in the border zone. Additional L-39s were assigned to the 1st Fighter Regiment at Planá Airbase, the 8th Fighter Regiment at Brno-Tuřany, and later to the 2nd Squadron of the rearmend 30th Attack Regiment at Pardubice. The final L-39ZA models arrived in 1990, with thirty delivered in total. As the Air Force underwent constant reorganisation, aircraft assignments shifted frequently. In July 1992, the newly relocated 1st Training Regiment at Přerov received the L-39MS model.

Aircraft not taken over by the Soviet Air Force were operated by Aero, with most eventually sold to private operators in the USA. A specific demilitarised model, the L-39CT, was introduced for this purpose. At the time of the federation split, Czechoslovakia operated 25 L-39Cs, 6 L-39Vs, 26 L-39ZAs, and 6 L-39MS aircraft. These were divided between the Czech and Slovak Republics on a 2:1 ratio.

Czech Republic

The Czech Republic assigned its L-39Cs to the 1st Training Regiment at Přerov, named after General Karel Janoušek - a WWII veteran who organised Czechoslovak squadrons within the Royal Air Force. The regiment was disbanded in 1994, and all jets were transferred to the 34th Training Base at Pardubice, which became the country's sole fast jet training base, operating L-39s under the 341st Training Squadron.

By the late 1990s, most L-39Cs had reached the end of their service life. To continue training, the OEM reused

Above left: A Czech L-39V during its time at Planá Airbase, identifiable by the bat emblem on the nose.

Left: The OEM operated multiple L-39s, including this L-39C.1 likely intended for the Soviet Air Force but never delivered. Although it bears the Czech lion symbol, it never flew under the Air Force.





Above: Formation flight of Czech L-39C.1 and L-39ZA.7. The former originally belonged to the Biele Albatrosy jet team and retained its colours.

Left: Another lavishly painted L-39C.1 operated by the OEM in the early 1990s. It was later delivered to Yemen.



components in newly produced airframes originally intended for the Soviet Air Force. Eight aircraft underwent this service life extension programme, receiving tactical grey camouflage and retaining their original tail numbers, despite being formally new airframes. Jets not selected for conversion due to poor condition were sold to the USA, donated to museums, or used as instructional airframes. Notably, the aircraft with serial 0105 was sold to the USA and, under registration N4213A, became a top-speed winner at several Reno Air Races. In 2004, the 34th Airbase was disbanded, and all jets were transferred to the newly created CLV (Centrum Leteckého Výcviku – Air Training Centre), a subsidiary of the state-owned LOM PRAHA aircraft overhaul facility. CLV took over all eight L-39Cs, one of which was lost in 2010 due to engine failure. Several L-39s remain in operation at Pardubice and are used for pilot training. All are scheduled to be replaced by the new L-39NG model, with four aircraft ordered in 2023 and two delivered in 2025.

Four L-39V aircraft were assigned in 1993 to the 1st Fighter Regiment at Planá for target towing during live fire training of MiG-21 and MiG-23 pilots. They were soon grounded and donated to museums, none having reached half their service life.

The L-39MS aircraft were also short-lived. Initially transferred to the 1st Training Regiment at Přerov, they featured advanced avionics and were used for international displays, including Fairford in 1994. However, they were flown to Pardubice in 1995, grounded, and later sold.

The L-39ZAs were transferred in 1993 to the 1st Fighter Regiment at Planá, the 11th Fighter Regiment at Žatec, the 82nd Independent Fighter Squadron at Ostrava-Mošnov (later relocated to the 4th

Centre left: Czech Air Force L-39MS.1 with emblems of Přerov Airbase units. The jet is armed with R-3S missiles.

Left: Fleet of L-39ZA.1 and two L-39C.1 jets flying near Kašperk Castle in the south-west of the country.



Right: Four L-39C.1 aircraft produced for the USSR, but shortly after production operated by the Aero Trio jet team of the OEM. These jets flew for several years prior to delivery. This image of four jets is rare.

Below right: Czech L-39C.1 operated by state-owned LOM PRAHA and its training centre CLV. It still carries the national insignia, which was later removed.

Independent Fighter Squadron at Přerov), and the 30th Attack Regiment at Pardubice. A major reorganisation in 1994 saw all L-39ZAs reassigned to the 4th Tactical Air Force Base at Čáslav and the 32nd Tactical Air Force Base at Náměšť nad Oslavou. The former unit dedicated one L-39ZA to the 'Stress Squadron,' a display team showcasing Air Force inventory domestically and abroad. Eventually, all L-39ZAs were consolidated at Čáslav, which was renamed the 21st Tactical Air Base in 2003. The type remained in service until 2019, when the L-39ZA was officially retired.

Aero operated several aircraft before selling them to private owners. One, numbered 5321, starred in the James Bond film *Tomorrow Never Dies*, filmed in the Pyrenees alongside two ex-German L-39ZOs. The OEM later operated an aircraft with fuselage code 2626, originally named L-39CA. It was reacquired from the Ukrainian Air Force for a project assessing service life consumption. It was later upgraded with a HUD display and used as a technology demonstrator for the L-39NG project. The aircraft was fitted with a Williams FJ44-4M engine and Genesys avionics, and completed its second 'maiden' flight in September 2015.

In April 2000, the Czech Air Force formally received its first three L-159A light



attack aircraft at Čáslav Air Force Base, later followed by additional deliveries, totalling seventy-two aircraft across Čáslav and Náměšť nad Oslavou bases. Following the Czech Republic's sudden accession to NATO, defence policy changes led to significant budget cuts. As a result, half of the L-159As were grounded, and the Náměšť units were disbanded.

In 2007, the Air Force received its first L-159T1 two-seater, followed by five more, all converted from stored surplus airframes. Notably, two of these, along with three L-159As, were delivered to the Spanish company CASA as part of a partial barter exchange for new C-295 aircraft. CASA intended to use the L-159s for advanced training, but the plan never materialised. While the three L-159As were later sold to the USA without Czech authorisation, both L-159T1s were returned to the Czech Republic as compensation for issues with the C-295's defence systems, which failed to function properly. As they had been removed from the military register, they were reissued with new fuselage numbers.

One L-159T1 was subsequently sold to Iraq, while the remaining five were upgraded to the improved L-159T1+ standard. Three additional L-159T2 aircraft were built from

Above left: Later paint scheme of the Czech CLV L-39C.1 with low-visibility roundel. Note the missing Czech lion and 'Czech Air Force' stencil.

Left: Final Czech CLV L-39C.1 paint scheme with rectangular national roundel and CLV titles. The colour is matt, like all CLV jets.



Above: Czech Air Force L-39ZA.7 in a livery marking the 50th anniversary of the L-39 maiden flight. The tail fin features a portrait of Rudolf Duchoň, the first L-39 pilot.

Right: 'Albatros takes a bath' – paint on a Czech L-39C.1 is chemically removed with a water jet. Unlike grinding, this method helps prevent material degradation.

scratch, with the final L-159T2 completed in 2018 - marking the last L-159 ever produced. All L-159s remain in service at Čáslav Air Force Base, though the fleet is expected to be reduced following the introduction of the F-35.

Djibouti

Djibouti never became a formal operator of the L-39. However, in 1991, an Ethiopian L-39C.1 landed in the country, and the pilot requested political asylum. The aircraft was never returned and was eventually scrapped for usable parts before being dismantled entirely.

East Germany

East Germany was one of the earliest export customers and the closest foreign operator of the L-39. Its LSK NVA Air Force (Luftstreitkräfte der Nationalen Volksarmee – Air Force of the National People's Army) ordered the L-39ZO model in 1976, just ten years after receiving its final L-29. The new jets were intended for extended weapons training and advanced pilot instruction.

The first aircraft were delivered in October 1977 via a short ferry flight from Aero to Bautzen Airbase - less than 200km, shorter



than domestic deliveries to Košice. Later that year, seventeen more jets in the unified L-39ZO.5 standard were delivered, all assigned to FAG-25 (Fliegerausbildungsgeschwader Leander Ratz), where TL-39 simulators were also installed. These aircraft operated alongside L-29s and MiG-15UTIs.

In 1982, the final four L-39ZO.1 aircraft were delivered, bringing the total to fifty-two. The L-39s were heavily utilised, with frequent formation flights - sometimes involving up to twenty jets simultaneously. Firing drills were extensive, including launches of R-3 missiles.

Training flights were primarily conducted at Bautzen, though Heringsdorf Airbase was used biannually.

Due to positive operational experience, East Germany ordered two L-39V target towing models. As these were no longer in production and towing components from MiG-15s were unavailable, the Czechoslovak Air Force released two aircraft from its active inventory, making East Germany the sole export operator of the L-39V. Both were assigned to ZDK 30 (Zieldarstellungskette – Target Towing Squadron) at Peenemünde Airbase, replacing unpopular Il-28 bombers previously used for the role. Three standard L-39ZOs were later redirected there from Bautzen for weather checks, crew recurrency training, radar calibration, and anti-aircraft battalion exercises. Pilots from ZDK 30, stationed on the coast, frequently flew in immersion suits.

Two aircraft were lost in accidents - one due to engine failure, and the other following pilot error when a cadet lost control while testing parameters for his thesis. In 1989, all jets were relocated to Rothenburg Airbase during runway reconstruction at Bautzen.



Left: One of two East German L-39V aircraft during taxiing. Note the reel of the towing ram turbine under the fuselage and the empty rear cockpit with no seat installed.



Above: Typical East German paint scheme of the L-39ZO.4. Note the 'Q' symbol on the nose, indicating a perfectly maintained jet with high airworthiness.

After German reunification, Luftwaffe markings were applied to the aircraft, though they flew infrequently. Most pilots were discharged, and Eastern-standard training ceased. The jets were formally accepted into the unified Luftwaffe but were retired shortly thereafter.

Egypt

Egypt became the second-largest operator of the L-29 after the USSR, receiving 122 aircraft between 1966 and 1969. These were primarily used for pilot training at Bilbais Air Force Academy, located approximately 70km

northeast of Cairo. In combat roles such as light attack and reconnaissance, the L-29s were deployed during conflicts with Israel - ironically supported by Czechoslovakia decades earlier.

Political tensions between Egypt and Czechoslovakia in the 1970s led to a lack of OEM support when Egypt needed it most. Consequently, aircraft were overhauled locally at a maintenance facility in Helwan, now a suburb of Cairo. By 1979, only half of the L-29 fleet remained operational, prompting Egypt to seek replacements.

France, already established in Egypt

through Mirage fighters and Gazelle helicopters, supplied Alpha Jet trainers in both training and counter-insurgency variants. These arrived at Bilbais in 1983 and took over advanced training. However, the Alpha Jets proved difficult to maintain, and President Hosni Mubarak accepted Libya's offer to supply surplus L-39ZO aircraft. This plan was publicly revealed in 1990 when Libyan leader Muammar Gaddafi mentioned it to the press without consulting the OEM. It was expected that up to forty Libyan aircraft would be delivered, symbolising a new partnership between the two nations. Ultimately, only twelve aircraft were transferred to Egypt between 1992 and 1993, all based at Alexandria Airbase. These aircraft, originally produced in 1978-1979, had undergone general overhaul in Libya. They were used for training and surveillance missions and were temporarily relocated to Minya Airbase during runway reconstruction at Bilbais.

One aircraft was lost in an accident, and the remainder remained operational until 2001, when the first underwent general overhaul in Slovakia - where L-29s were also refurbished. Some sources suggest the aircraft remained in service beyond 2009.

In 1992, Egypt signed a deal with Aero Vodochody for the delivery of fifty L-59Es, equipped with DV-2 engines. These were intended to replace the ageing L-29 fleet and unify Egypt's fragmented flight training system, which at the time included Ghumorea piston aircraft (a post-war copy of the B cker B  181 with Continental engines), EMB 312 Tucano turboprops, L-29s, and Alpha Jets.

The modern onboard systems of the L-59E enabled both elementary and advanced training, with seamless transition to MiG-21, F-16, and Mirage 2000 fighters. In 1992, a

Above left: Egyptian L-59E with auxiliary fuel tanks during a photo sortie over the Czech Republic. Note the Soviet-made ZSh-5 pilot helmets worn by both crew members.

Left: Flightline of Egyptian L-39ZO.1 aircraft, all originally delivered to Libya and re-exported to Egypt following overhaul.



Right: Equatorial Guinea operated the L-39C.1 model from Ukrainian surplus. Despite serving in Africa, it retained the typical Ukrainian paint scheme.

group of Egyptian pilots and mechanics travelled to Czechoslovakia for training. Ground personnel were trained at the 1st Aviation Training Regiment in Přerov, the sole operator of the L-39MS at the time. Aero used the L-59E prototype 0101 and the non-flyable prototype 0102 for instruction.

Following training, the OEM began ferrying aircraft to Bilbais in February 1993. With reduced international political pressure, these were the first Aero jets to fly to Africa without quasi-civilian registrations. As part of the delivery, Egypt also received TL-59E simulators and ejection training devices. The initial years of L-59E operation in Egypt were plagued by technical difficulties, primarily related to the DV-2 engine. In 1993, three accidents occurred within three months. The first took place in September at the Aero airfield, where a company crew crashed one aircraft prior to delivery due to pilot error. The landing pattern failed to account for the four auxiliary fuel tanks under the wings, causing the aircraft to lose altitude, stall, and crash. Both pilots survived, but only forty-nine of the originally ordered fifty aircraft were ultimately delivered.

One month later, another aircraft crashed in Egypt following an engine shutdown during low-level flight. The crew ejected successfully. In November, a third crash occurred under unusual circumstances. The crew attempted to retract the undercarriage at an altitude of 6km, apparently unaware that having the gear down disables the engine's anti-surge system. The engine surged and could not be restarted. The pilots performed an emergency belly landing in the desert. As dust enveloped the aircraft, fearing an onboard fire, both pilots ejected. Tragically, one pilot landed in power lines and died from high-voltage burns.

The OEM developed several engine modifications, and two upgraded aircraft were tested at Bilbais Airbase. Although the tests

Below: Estonian L-39C.1 operated by KS Avia, parent company of the Baltic Bees jet team, but leased to the Estonian Air Force.



concluded successfully in mid-1994, the Egyptian Air Force did not regain confidence in the aircraft. Compounding the issue, some aircraft stored outdoors suffered corrosion from salty fogs, and by 1996, L-59E operations ceased entirely. The fleet, averaging just four years old, was placed in storage.

Between 1999 and 2000, Aero attempted to restore twenty-four aircraft to airworthy condition, drawing on operational experience from Tunisia, the second L-59 operator. However, one aircraft suffered an in-flight electrical generator failure, resulting in an onboard fire and a forced emergency landing. This incident marked the final straw for the Egyptian Air Force, which shifted its focus to the Chinese K-8 model - though its operation was not without issues either. The L-59Es remained stored at Bilbais for years and were periodically offered for sale.

Equatorial Guinea

Equatorial Guinea, one of Africa's smallest nations, has developed a relatively mature air force, primarily based on ex-Ukrainian aircraft. Following the delivery of Su-25 and Su-25UB models from Ukraine, the country ordered L-39C.1 aircraft from Ukrainian surplus stocks. These jets were intended for both training and light combat missions, enabling domestic pilot preparation for the first time. In 2007 two L-39Cs were delivered

and assigned to the Esquadra Operacional at Malabo Airbase, where most of the country's jets are stationed. Their fuselage numbers were changed during service, leading to erroneous reports of four aircraft being delivered. Both jets have remained operational until recently.

Eritrea

Eritrea briefly encountered the L-39 in 2014 when an Ethiopian pilot defected with his aircraft. The jet was evaluated on the ground, and its integration into Eritrea's Russian-based inventory was seriously considered. However, due to its poor technical condition, the aircraft was ultimately scrapped.

Estonia

Estonia did not inherit any L-39s following its independence, despite ambitions to establish an air force. Budget constraints prevented direct procurement, although a local private company acquired six L-39s from Kyrgyzstan. In 2005, the Estonian Air Force launched a jet training programme using private contractors due to financial limitations. Jets from Germany's Art on Air team, the Netherlands' Skyline Aviation, and Estonia's KS Avia (operator of the Baltic Bees Jet Team) were used. These aircraft retained their team liveries and operated from Ämari Airbase, with a maximum of two jets active at any given time.





Above: Current paint scheme applied to Ethiopian L-39C.1s, yet to receive national insignia as the jets are in the final stage of general overhaul.

Right: Ethiopian L-39C.1 photographed at the OEM's airport prior to delivery. The aircraft have changed national insignia several times since.

Ethiopia

In the 1960s, Ethiopia operated several US-origin aircraft. Following a regime change, the country turned to the USSR for new inventory. As the USSR could not supply Eastern-standard training jets, Ethiopia used F-5s to train future MiG pilots, facing significant challenges.

In 1981, Ethiopia ordered ten L-39C.1s from Aero, originally assigned to the Soviet Air Force. Delivered in 1983, they were assigned to a training unit at Harar Meda Airbase near Debre Zeit. Pilots transitioned to the L-39 after initial training on Italian-made SF-260 aircraft. In 1988, ten more L-39s were delivered, and the Air Force reopened its air college. However, the system was short-lived. The Air Force relied heavily on Soviet instructors, all of whom left in 1991. During the ensuing civil war, L-39s were used in low-intensity combat. One pilot defected to Djibouti in protest at combat missions.

Training resumed in 1992, but many jets were in poor condition. Six additional L-39Cs were procured from the OEM, originally intended for the USSR but never delivered. Following renewed conflict with Eritrea, many jets were damaged. In 2004, five L-39ZA.1s were acquired from Bulgaria, though only four original L-39C.1s remained in inventory. The maintenance centre at Harar Meda became defunct, and the Air Force relied on ex-CIS and Bulgarian contractors.



Some pilots were sent to Israel for training, where three former L-39 instructors sought asylum. Despite these challenges, Ethiopia maintained a small operational fleet. In 2014, another pilot defected - this time to Eritrea.

In 2019, an agreement was reached with Aero to upgrade twelve L-39s to the L-39CG standard, featuring L-39CW avionics but retaining the original engine. All work is being carried out by OEM crews at Bishoftu Airbase (formerly Debre Zeit).

Ghana

Historically, Ghana operated L-29s acquired from Nigerian surplus. By 1993, seeking a more modern type, the Air Force accepted Libya's offer to transfer two L-39ZO.1 aircraft, including ammunition. These were assigned to the 1st Light Combat Squadron at Kotoka Airbase near Accra, alongside Cessna 172 Skyhawk trainers.

The aircraft were deployed in border clashes and flown by former East German mercenaries. They remained operational until 1999, when both were sent to Slovakia for general overhaul. Returning in fresh paint a year later, they served under the 4th Squadron for another decade, supported mainly by Ukrainian contractors. The jets are sometimes misidentified as L-39Cs due to the removal of one pair of wing hardpoints. Notably, female cadets flew the type, including Ghana's first native helicopter pilot, Selase Yayra Agbenyefia, who completed her basic course on the L-39.

In recent years, the L-39s and MB-339s were retired and replaced by Chinese K-8s. One L-39 now serves as a gate guardian. In 2021, reports surfaced of Ghana's intent to procure six L-39NGs, but the deal never materialised.

Georgia

Georgia established its Air Force in 1992. Unlike many post-Soviet states, it did not inherit Soviet aircraft, as few aviation units had been stationed on its territory. Nevertheless, the leadership actively sought aircraft, especially after combat operations began in Abkhazia, where Georgia lost several Su-25s and Mi-24s. To train pilots, ten L-29s were ordered from Ukraine, serving for a decade. In 2006, eight L-39C.1s were purchased from Ukraine, followed by four



Left: Georgian L-39C.1 – a typical example of the global reach of Ukrainian overhaul plants, which delivered surplus L-39s to many countries.

Right: Originally East German L-39V shortly before the unified Luftwaffe fuselage code and German cross were applied. However, the L-39 fleet was short-lived in reunified Germany.

more in 2007, intended to replace the ageing L-29 fleet. These were based at Marneuli-Sandar Airbase and survived the 2008 Russian invasion, unlike some L-29s used as decoys. Training continued post-war, beginning with the Yak-52. Recent information on the number of airworthy L-39s is unavailable, though one aircraft was withdrawn following an accident, and the remaining fleet is reportedly in need of refurbishment.

Germany

Germany inherited fifty L-39ZOs and L-39Vs following reunification, and all were formally accepted into the Luftwaffe, receiving German crosses and four-digit fuselage codes. However, with the rapid withdrawal of MiG-21s, MiG-23s, and Su-22s, the L-39s had no clear role. Only the MiG-29s remained in service temporarily due to a shortage of fighters in the newly unified country.

ZDK 30 was disbanded in October 1990, and FAG 25 training squadron was officially dissolved on 22nd December 1990. Two months prior, all L-39s were relocated to Rothenburg Airbase for long-term storage, alongside helicopters and other aircraft, while runway reconstruction at Bautzen was suspended. Luftwaffe training continued on Alpha Jets, and the L-39s were



decommissioned. Six aircraft were sold to private companies Aero Phoenix and Kaiser. In 1993, Germany proposed transferring the remaining fleet to Poland and later to Hungary. Warsaw declined, requesting MiGs and Mil helicopters instead, while Budapest accepted and gradually took over twenty-four jets. Remaining aircraft were donated to museums or sold to private owners.

Notably, one jet purchased by Aero Phoenix was briefly operated in the UK before being acquired by Dutch-based Skyline Aviation, which used it for simulation services. It was later operated over Germany in target towing and electronic warfare simulation roles.

Hungary

Hungary never purchased the L-39 directly from the OEM, having operated only the L-29 until 1993. However, Hungarian pilots and mechanics gained L-39 experience through training in Slovakia, particularly at the Košice-based squadron near the Hungarian border. This arrangement, considered economical due to the low number of trainees, remained in place until 2008.

In 1993, Hungary agreed to acquire two dozen L-39ZOs stored at Rothenburg Airbase. Germany formally sold them for one Deutsche Mark per aircraft, including simulators, training aids, and spare parts. The aircraft were delivered by truck and rail. Twenty jets were made airworthy; three were used for spares, and one was assigned as an instructional airframe at Szolnok Aviation College.

All aircraft were operated by the 1st Training Squadron of the Air Force Academy at Szolnok Airbase, which was administratively based at Kecskemét. The first flight occurred on 3rd March 1994, with regular training commencing shortly thereafter. One aircraft was lost in an accident in 1995, and another in 2008. In 2002, a

Left: Shark-mouthed L-39ZO.4 was the flagship of the Hungarian L-39 fleet for a time. It was later sold and operated under Russian registration in Europe until it crashed.

Below: Hungarian L-39ZO.4 delivered from Germany in a modified paint scheme with repainted German insignia. This particular aircraft ended up with the Mozambique Air Force.



Right: Iraqi L-39C.2 in the Air Force Academy paint scheme prior to delivery. Note the early-style auxiliary fuel tanks without stabilisation fins.

Hungarian pilot ejected from a Slovak L-39ZA during an incident at Košice Airbase.

In the mid-1990s, all L-39ZOs were assigned to the 57th Fighter Regiment's 3rd Training Squadron, Pegas, later reorganised into the 59th Tactical Fighter Regiment Dezső Szentgyörgyi. Between 1998 and 2000, twelve jets were refurbished in Hungary with Aero's support and repainted in Hungarian camouflage. Later upgrades included GPS receivers and new transponders. In 2005, one jet received a hornet-themed paint scheme, and in 2007, two jets were partially repainted with shark-themed nose art, becoming the most recognisable aircraft in the fleet.

Following Hungary's accession to NATO in 1999, long-term pilot training was arranged in Canada to meet Western standards. Despite sufficient capacity abroad, the L-39s remained in use. In 2001, they were employed for MiG-21 pilot re-currency training and for rocket and bombing practice.

Between 2004 and 2005, eight aircraft underwent service life extension by Aero and remained in service until 2010. The final training flight occurred on 25th November 2009, with the last technical ferry flight on 30th June 2010. Before decommissioning, the Ministry of Defence contracted flight hours on Aero's L-159B prototype. Over 800 hours were flown in 2008–2009, with all future Gripen pilots completing their 'Westernisation' course on the L-159. As partial payment, some L-39ZOs were transferred to Aero, one of which was later sold to Mozambique. The rest of the fleet was sold to the USA. Three aircraft are now displayed at the Szolnok Aviation Museum. In 2022, Hungary announced plans to purchase twelve L-39NG aircraft, including two in ISR configuration. This followed Hungarian entities acquiring a majority stake in Aero.

Iran

Iran has never operated the L-39. However, in 1991, two Iraqi L-39ZOs landed in Iran, piloted by defectors fleeing the country during the Allied offensive. One aircraft made an emergency landing near Sardasht, while the other landed at Hamedan Airbase, escorted by Iranian jets.



Iraq

Iraq was one of the largest L-39 operators. The Iraqi Air Force operated seventy-eight L-29s and numerous Zlin Z-526 piston trainers. The L-29 remained in use for elementary training even after the L-39 was introduced, which took over advanced training for pilots transitioning to MiG-21s, MiG-23s, and Mirage F1s.

In 1975, Iraq received twenty-two L-39C.2 aircraft in several batches. Between 1976 and 1977, 28 L-39ZO.6 aircraft were delivered, followed by 30 L-39ZO.7 aircraft between 1981 and 1985. Iraq also acquired TL-39 simulators and ejection training devices. Aircraft were ferry-flown to Iraq with support from Aero-operated L-410AS transport aircraft, while ground support equipment was delivered by rail.

Despite lacking civilian avionics or transponders, ferry flights followed civilian airspace rules, routing through Bratislava, Belgrade, Sofia, Ankara, Diyarbakır, and finally to Tikrit or Baghdad. Some later flights bypassed Turkey via Yugoslavia and Greece. One delivery ended in tragedy on 28th January 1977 when an aircraft crashed due to instrument failure and disorientation in cloud. The pilot, a former member of the Czechoslovak parliament, had joined Aero after his political career.

Most L-39s were stationed at Al Sahra Military Training Academy near Tikrit, Saddam Hussein's birthplace, with advanced training conducted at Mosul Airbase. The syllabus included initial training on AS-202 Bravo piston aircraft and EMB 312

turboprops, followed by L-29 and L-39 flights. Pilots typically logged eighty hours on each jet, including 20 solo hours, before progressing to MiG-15UTI and MiG-21U. Although Soviet advisors influenced Iraq's Air Force structure, training followed British standards. Notably, the syllabus lacked degraded visual condition training, and the L-39ZO lacked the RSBN-5S short-range navigation system, which was ineffective in visual-only operations.

Beyond training, Iraq used the L-39ZO for low-intensity combat missions. Initially, a five-aircraft unit operated from Al Sahra, later replaced by L-39ZOs. Aircraft were armed with S-5 FFAR rockets and FAB-250 bombs for operations from Kirkuk and Mosul against Kurdish positions in the northeast. During the Iran–Iraq War, L-39s were used for monitoring but not direct combat. Two were destroyed in an Iranian raid on Kirkuk in 1983.

Some aircraft were refurbished in Czechoslovakia in the mid-1980s, but fleet numbers declined. During Desert Storm and Desert Shield, two L-39ZOs were destroyed and eight damaged. Two aircraft defected to Iran, and three were captured by US forces and shipped to the USA along with MiG-25s, Su-24s, Mi-8s, and Mi-24s. A small batch of L-39ZOs was at Trenčín overhaul facility in Slovakia in 1991 and was never returned. US companies later acquired them. Arms embargoes further reduced the fleet, and by 1995, only around two dozen aircraft remained operational. Following the 2003 coalition invasion, US forces secured over thirty L-39s at Al Sahra, in varying condition. All were eventually scrapped during reconstruction of the base, renamed FOB Speicher. Currently, Iraq no longer operates the L-39.

After years of negotiation, Iraq returned to Czech aviation products in 2015, signing a contract for the delivery of ten L-159A light combat aircraft and two L-159T1 trainers. The aircraft were sourced primarily from Czech Air Force surplus, although three L-159As and one L-159T1 were sold directly from the active inventory due to Iraq's urgent need for jets to combat ISIS. The first two aircraft were delivered to Balad Airbase, north of Baghdad, in November 2015 and assigned to the newly formed 115th Squadron, which operated

Left: Another Iraqi L-39ZO.6 during handover in Czechoslovakia, also featuring early-style fuel tanks that were soon phased out.



Right: Kazakh L-39C.1 in a lavish paint scheme applied during overhauls in Slovakia. All jets were painted identically, so the Sunkar jet team required no special livery.

exclusively L-159s. Pilots and mechanics underwent full training in the Czech Republic. The L-159s were widely deployed in combat operations against ISIS, typically armed with two to four Mk.82 general-purpose bombs.

Islamic State

The Islamic State became an internationally unrecognised operator of the L-39. After seizing Syria's Kshesh Airbase in 2013, ISIS captured at least six L-39ZO.2 and L-39ZA.2 aircraft. Two jets were destroyed and one damaged by an anti-tank missile explosion, but at least three were captured intact. A video circulated online showing one jet provisionally resprayed in ISIS colours, taxiing at the base. Within a year, two jets were destroyed during Syrian government offensives, while the last aircraft was flown to Tabqa Airbase in Raqqa, then under ISIS control. That jet was later damaged during Russian airstrikes.

Kazakhstan

Kazakhstan inherited a vast array of military equipment following the collapse of the USSR, including Tu-95MS strategic bombers and MiG-31 interceptors - among them the MiG-31D variant designed for anti-satellite missions. Although Kazakhstan was the last Soviet republic to declare independence, no aircraft were flown out during negotiations with Moscow. By 1993, Kazakhstan had one of the largest air forces globally, with 714 aircraft, including 16 L-39 trainers. However, most ceased flying due to a lack of spare parts. The country sought to maximise its inherited assets and agreed to transfer thirty-three Tu-95s to Russia in exchange for twenty-one MiG-29s, twenty-four Su-27s, and fourteen Su-25s. Additional exchanges brought thirteen L-39Cs in 1998 and 1999.

All L-39s were operated by the 609th Airbase near Lake Balkhash, which also housed a full flight simulator. During service, the jets were overhauled in Slovakia and repainted in an elegant blue-yellow livery reflecting national colours. In 2010, a six-ship demonstration team named Sunkar (meaning 'falcon' in Kazakh) was formed, composed of instructor pilots from the training base.

Their first public display took place during Independence Day celebrations in



2011, followed by an international presentation at the KADEX exhibition in Astana in 2012. By 2013, 22 L-39s were operational, occasionally flying from Aktobe Airbase for navigational sorties. Cadets progressed to the L-39 after initial training on German-made Grob aircraft operated by the national aeroclub.

Although plans to introduce Yak-130 trainers were announced in 2014, another round of L-39 overhauls was chosen instead. The first aircraft were sent to the OEM in the Czech Republic in 2019. Since then, most jets have undergone refurbishment and received the L-39CW avionics suite. All were repainted in a two-tone tactical grey camouflage inspired by the L-39CW prototype.

Kyrgyzstan

Following the USSR's dissolution, Kyrgyzstan inherited seventy-two L-39C.1 aircraft from the 5th Air Force Pilot Training Centre, spread across Frunze 1, Kant, and Tomkak airbases. An additional two dozen jets were undergoing overhaul in Ukraine and were never returned. Maintaining such a large fleet proved economically and militarily impractical for the newly independent republic. Kyrgyzstan began selling aircraft to fund its defence budget. Some jets were sold to Lithuania, Ukraine, and private companies in the USA, including Air USA, which

acquired twenty-one L-39s along with MiG-21bis and MiG-29A fighters. Although several dozen jets remained in-country, only two were operational by 1993. The Kyrgyz Air Force's tactical branch had just one MiG-21 in active duty, and few pilots were needed. Operational numbers increased in the late 1990s as the Air Force was used to suppress rebel activity near the eastern border.

The L-39s proved effective in raids against Mujahideen, particularly when armed with 50 and 100kg free-fall bombs. Their low-speed approach enabled relatively precise targeting, and bomb blasts in mountainous terrain triggered massive rock avalanches. Combat operations were sporadic, with renewed activity in 2002 and 2004.

In 2004, Russia provided general overhaul for four L-39C.1s, which were used for pilot training and patrol missions around Kant Airbase near Bishkek. As the L-39 remains Kyrgyzstan's sole jet trainer, elementary training is contracted to Russia. The Russian Air Force also operates from Kant, deploying Su-27s, Su-25s, Su-24s, and later Su-30s, supported by two L-39C.1s under the 'Collective Rapid Response Forces' framework.

Libya

Libya began military cooperation with Czechoslovakia in 1969 following the establishment of the Libyan Arab Republic. Several intergovernmental agreements were signed, covering military and technical aid. With a substantial defence budget funded by oil revenues, Libya was able to procure high-end equipment and paid reliably - unlike many other African nations. It became the second-largest export operator of the L-39 after the USSR, ordering a total of 181 L-39ZO aircraft. Negotiations began in 1976, with the contract signed in 1978. Libya demanded not only aircraft but also significant technology transfer and a long-term presence of Czechoslovak instructors.

Muammar Gaddafi himself visited Czechoslovakia in 1978 to finalise the deal. The L-39 was selected to replace the Fouga



Left: Current paint scheme of Kazakhstan's L-39C.1s after general overhaul and modification performed by the OEM in the Czech Republic.

Right: Libyan L-39ZO.1 with early-style auxiliary fuel tanks. Note the jet carries the Czechoslovak flag and OK-KXF registration for its ferry flight.

Below right: Many Libyan L-39ZO.1s ended up open-stored in the desert, with UV degradation and sand abrasion clearly visible on the canopy transparencies.

CM-170 Magister and was intended to prepare pilots for both Western and Eastern-origin jets. The scale of the programme was immense, requiring hundreds of Czechoslovak instructors and advisors across multiple bases. By the mid-1980s, over 300 Czechoslovak specialists were stationed in Libya, remaining until 1990. Initially, instructors were drawn from the Air Force, but later even civilian pilots were retrained in military schools and sent abroad. It became the largest foreign project undertaken by the Czechoslovak aviation industry outside the USSR. The programme also offered a rare opportunity for Czechoslovak personnel to earn substantial income and access Western goods unavailable behind the Iron Curtain. Eventually, families were permitted to join the instructors, and several Czechoslovak schools were established in Libya to support the expatriate community. The initial batch of 35 L-39ZOs was delivered to Libya in 1978. These jets were equipped with rescue dinghies for coastal flights, and crews wore inflatable vests. All aircraft were flown from Czechoslovakia to Africa bearing civilian ferry registrations on the tail. One aircraft was lost during the first ferry flight over Czechoslovakia, resulting in the deaths of both pilots. By 1983, all 181 ordered jets had been delivered.

For navigation, the aircraft were temporarily fitted with Bendix King systems, which were removed upon arrival in Libya and reused for subsequent deliveries. Ferry flights were typically accompanied by Czechoslovak or Libyan airline aircraft, military transports, or other support types. Several TL-39 simulators were also delivered. In Libya, the jets operated from multiple bases. Mitiga Airbase, located in the suburbs of Tripoli, housed the 1st Training Regiment. Originally based near the Uqba ibn Nafi perimeter, the unit relocated to the newly constructed Mitiga facility, which offered a

Below: L-39ZO.1 operated by the Libyan Government of National Accord Air Force after defection and emergency landing in Tunisia. Note the live bombs under the wings.



large training airspace over the Mediterranean Sea. The largest operator of the L-39ZO was the Al Zawiyah Air Force College, initially based at Uqba ibn Nafi but moved in 1980 to Misurata Airbase, east of Tripoli, where the 2nd Training Regiment was stationed. The remainder of the fleet was assigned to Brak Airbase, located in central Libya's desert, which also operated detachments from other bases. Brak became the hub for desert flight operations. Each unit operated TL-39 simulators.

In the training syllabus, the L-39 followed elementary instruction on Italian SF-260 trainers. Libya also operated 120 Yugoslavian G-2A Galeb jets for basic and advanced training. A large maintenance and overhaul facility was built at Tamanhint Airbase, one of the few authorised by Aero to perform

general overhauls. Initially, training was conducted by Czechoslovak instructors, mechanics, and air traffic controllers. Due to Libya's British-influenced aviation heritage, training was delivered in a mix of English, Russian, and Czech, with interpreters commonly used. Air traffic communication was conducted almost exclusively in English.

Some cadets were as young as sixteen when they first flew the L-39, and instructors recalled that physical punishment was sometimes used - such as striking the back of the front-seated cadet with a wooden stick from the rear cockpit - practices uncommon in Europe. Later, even female cadets as young as fourteen were assigned to L-39 training. Initially, the jets were used to stabilise Libya's instructor cadre. Arab instructors received training and type ratings in Czechoslovakia



Right: Lithuanian L-39C.1 obtained from Kyrgyzstan, with original Soviet insignia repainted and new Lithuanian roundel and tail code applied.

Below right: Brand-new Lithuanian L-39ZA.4 originally produced for Nigeria but delivered to Lithuania. It retains the same paint scheme as Nigerian aircraft.

before being certified to teach in Libya. Pilots from Algeria, Ghana, Niger, and other African nations were also trained in Libya.

Operations were not without incident. Navigation errors, pilot mistakes, and technical failures led to around three dozen serious accidents with multiple casualties. In the late 1980s, L-39s were equipped with S-5 rockets and used for surveillance missions, particularly during clashes with Chad. The jets were deployed in Libya's invasion of northern Chad, where ten were seized and two shot down by ground fire.

With more jets than needed, Muammar Gaddafi donated aircraft to other nations: three to Uganda, two to Nigeria, twelve to Egypt, three to Ghana, and one to Angola - part of Libya's broader strategy to extend its influence. Following Libya's implication in the Lockerbie bombing, Czechoslovak military aid declined sharply. After the fall of communism in Eastern Europe, Libya lost its support network almost overnight. Aero and the Czechoslovak Air Force withdrew personnel, who were later replaced by Ukrainian and Slovak mercenaries.

In the mid-1990s, Ukraine's Odessa-based overhaul facility launched a programme to restore two dozen L-39s, but it was halted due to international sanctions and pressure. Similar plans by Bulgarian and Slovak companies also failed. The situation improved in 2004 when sanctions were lifted. Fewer than thirty jets remained operational, and Libya urgently sought spare parts. Russia appeared to be a viable partner, and Libya ordered Yak-130 trainers. Some L-39s stored at Brak, Mitiga, and Misurata were slated for overhaul in Russia, but the plan collapsed during the Arab Spring.

Today, the Libyan National Army operates a small number of L-39s from Brak, while the rival Government of National Accord flies them from Misurata. Together, they maintain roughly a dozen aircraft; the rest are either damaged, dumped at airfields, or in storage. In July 2020, a Government of National Accord L-39 defected to Tunisia, landing near Mednine. The pilot stated he refused to bomb targets in Tripoli with the two FAB-100 bombs the jet was carrying.



Lithuania

Lithuania did not inherit any L-39s after independence, as Soviet units either flew their liaison aircraft back to Russia or did not operate the type. However, recognising the L-39's potential, ten instructors and two dozen mechanics joined the newly formed Lithuanian Air Force. After evaluating several options, a group of pilots and mechanics travelled to Bishkek, Kyrgyzstan, to select future trainers. Four jets were purchased in cash, secretly carried by the Lithuanian crews. The ferry flight to Siauliai Airbase was

accompanied by a slow-flying An-2 and took two months due to the L-39's limited range and bureaucratic delays.

All aircraft were assigned to the 11th Fighter Squadron and used for cadet training following Yak-18 and Yak-52 elementary stages. One jet was damaged in a landing accident, and another was donated to Vilnius

Below: Final paint scheme variant of the Lithuanian L-39ZA.4, shown here after general overhaul and modest upgrade by the OEM.

Right: Cockpit of the overhauled Lithuanian L-39ZA.4. The front cover of the instrument panel was 3D-printed on this aircraft instead of using the typical metal sheet.





Above: Mali Air Force received a fleet of L-39C.1s from Russia. All jets underwent general overhaul prior to delivery and are believed to have come from Russian surplus.

Technical University as an instructional airframe. The ex-Kyrgyz L-39C.1s lacked significant weapon capability, prompting the Ministry of Defence to acquire armed L-39ZA models. Two aircraft in the L-39ZA.4 standard - originally built for Nigeria - were handed over in 1998. They were used for training and airspace patrols.

After 2005, NATO fighter deployments took over air policing duties, and the L-39ZAs were relegated to training. Both underwent general overhaul in Romania between 2007 and 2008. One was destroyed in a mid-air collision with a French Mirage 2000C during a photo sortie. The surviving aircraft was overhauled at Aero in 2016, including mandatory upgrades. The Air Force explored leasing additional jets, but the plan never materialised. The sole remaining aircraft was assigned to the advanced attack unit Lengvas Ataka Lektuvos Grandis at the 1st Aviation Airbase in Siauliai. In April 2024, Lithuania confirmed the jet had been donated to Ukraine, along with available ammunition.

Luhansk People's Republic

The Luhansk People's Republic declared independence from Ukraine in April 2014 and, with Russian backing, attempted to establish a small air force. During clashes with Ukrainian forces, it seized several aircraft types following emergency landings, some of which were repaired and operated. Among these were four Mi-24s, two An-2s, one Yak-52, one Su-25, one L-29, and one L-

39. The L-39 was restored to airworthy condition and documented undergoing tests at a field airstrip near Luhansk, but it was soon destroyed in an air raid by the Ukrainian Air Force. Another L-39 was spotted at Luhansk Airport, though it was a disassembled museum airframe.

Mali

Mali became one of the most recent operators of the L-39, receiving four L-39C.1s in March 2021 as a gift from Russia, alongside Su-25s. These aircraft appeared to come directly from the Russian Air Force inventory, delivered in late Russian livery with only tactical codes and insignia repainted. The jets were provided as an interim solution to rapidly enhance Mali's air force capabilities. One aircraft was destroyed two years later, prompting further deliveries in 2023, bringing the total to thirteen L-39C.1s. Prior to delivery, the later batches underwent full overhaul in Russia and received new paint schemes. All aircraft are based at Base Aérienne 101 in Bamako and assigned to the combat squadron Escadrille de Chasse, alongside Su-25s and A-29B turboprops. Their primary roles are training and patrolling, although they have been repeatedly shown equipped with UB-16-57 rocket pods.

Initially operated by Russian instructors affiliated with the Wagner Group, at least two local instructors now fly the jets. In September 2023, one aircraft was damaged during an emergency belly landing, and the

pilot was captured by rebels. Images of the jet - largely intact except for wing leading edge damage and an open canopy - circulated on social media.

Mozambique

Mozambique became a non-original operator of the L-39 through a Romanian arms dealer who also supplied MiG-21bis fighters. A single L-39ZO.4 was delivered in 2013 after a unique service history. Originally delivered to East Germany, the jet was transferred to reunified Germany, then sold to Hungary. After brief service there, it was returned to Aero as compensation for flight hours on a rented L-159B prototype. Aero later sold the non-airworthy jet to a private company, which resold it to Romania, where it underwent general overhaul. It is likely one of the few military jets to have flown under four national flags. Romanian personnel trained Mozambican crews at the military academy in Bacău and Boboc Airbase. Upon final delivery, the jet was decorated with a distinctive national emblem combining photographic and painted elements depicting a rising sun, corn leaves, and a lion's head. In 2014, the Romanian company delivered additional L-39ZA.1 and L-39ZO.4 aircraft. However, due to substandard overhaul work, the Mozambican Air Force grounded the jets a few years later. All L-39s were assigned to the fighter squadron Esquadra de Caça at Maputo Airbase.

Nigeria

Nigeria was a long-time operator of the L-29 before turning to Czechoslovakia in 1985 with an order for twenty-four combat-capable L-39 aircraft. Given their intended use for light combat and patrol missions, the L-39ZA model was selected. To align with Western-origin aircraft in Nigeria's inventory, all jets received avionics upgrades using Bendix King systems, earning the unique designation



Left: Originally ordered by Nigeria, this L-39ZA.4 was later repainted and delivered to Algeria. Captured shortly after the original deal stalled, it bears incorrectly sprayed Czech insignia.

Right: Nigerian L-39ZA.4 at Kano Air Base in late-era livery. The cannon was removed due to its training role, where every pound of thrust and reduced weight matters.

L-39ZA.4. The aircraft were delivered in two batches in 1986 and 1987, temporarily bearing civilian Czechoslovak OK registrations. TL-39 simulators and ground support equipment were shipped by sea. A further twenty-seven jets were ordered in 1990, prepaid and produced, but never delivered. President Ibrahim Babangida attempted to fund the purchase through an IMF stabilisation fund, which was denied due to political unrest. The jets remained with Aero, and Swiss-made PC-7s were also withheld.

Initially, the L-39s were Nigeria's primary training aircraft, operated from Kano Airbase under the 303rd Training Regiment, alongside Italian MB 339s. The unit was subordinated to the Training Command at Kaduna Airbase. Primary screening was conducted on US Vans RV-6 Air Beetles. After L-39 training, pilots transitioned to F-7 fighters - a Chinese MiG-21 derivative.

The L-39s were also used extensively in combat operations against Boko Haram, armed with S-5 rockets and 50 or 100kg free-fall bombs. Eight aircraft underwent service life extension in 2019, with three more overhauled at Aero in the Czech Republic. These were returned to Nigeria via a four-day ferry flight through France, Spain, Algeria, and Niger, flown by a multinational Aero crew. At least five aircraft have been lost in accidents.

Nicaragua

Nicaragua expressed interest in the L-39 as early as the late 1970s, and in 1978, a delegation visited Libya to familiarise themselves with the type. Following the Sandinista-led coup, ties with Eastern Bloc countries weakened temporarily. President Daniel Ortega later turned to Moscow in 1986, seeking MiG-21s and L-39s.

The Czechoslovak government was approached during Ortega's Moscow visit, but under Soviet advice, the request was not pursued. Ortega then turned to Libya, which promised 20,000 assault rifles, five SF-260 piston trainers, and three L-39ZOs from its inventory. All were to be delivered aboard Libyan Il-76 transport aircraft, but the Lockerbie bombing prevented flight approvals. Only two L-39s were delivered, arriving via cargo ship under a Cuban flag. Both were assembled and ground-tested but



never flown. They were documented at Managua Airbase as late as 1988. Between 2000 and 2001, Nicaragua attempted to repair or replace the jets, but funding was insufficient.

Romania

Romania ordered its first batch of eight L-39ZA.1s in 1980 to replace the L-29. These were flown by Czechoslovak crews to Boboc Airbase, while Romanian instructors underwent type rating training in Czechoslovakia. Further deliveries in 1982, 1983, 1984, and 1985 brought the total to thirty-two aircraft. TL-39 simulators and extensive technology transfer for local maintenance were included. All jets were assigned to the 20th Training Airbase at Boboc and the newly formed 20th Aviation Group – Fighter and Bomber Aviation School (Grup 20 Aviație Școală Vânătoare și Vânătoare-Bombardament). They were used for advanced training on Soviet and Romanian aircraft.

In 1987, a third-year aviation cadet attempted to defect using an L-39. During a solo navigation flight, he climbed to 5,000 metres, radioed a false engine issue, and entered a steep dive. He levelled off just above the ground, flew over Bulgaria into Turkey, and climbed after crossing the border. He circled at altitude until intercepted by Turkish F-4 Phantoms. Low on fuel, he landed on a grass strip near Kırklareli. The aircraft was later returned to Romania.

After 1990, the training system was

reorganised and twenty jets remained with the 20th training airbase, but this time subordinated to the applied aviation academy Școala de Aplicație a Aviației Aurel Vlaicu, with the remaining ships assigned to the 2nd squadron of the 49th fighter bomber base at the Lanca airbase. Although the domestic IAR-93 was newly preferred for training, it proved to be too demanding for new cadets, and the L-29s and L-39s were used as sole training jets later. Unfortunately, the lack of funds reduced the airworthiness of the fleet. It is worth mentioning that in 1997 the commander of the air force died in an L-39 accident. Due to budget cuts, the Lanca units were disbanded, and their jets were offered for sale, with sixteen jets eventually sold to private owners in the USA. The fleet of the 20th airbase was kept operational until 2007, when the last flight was recorded. The L-29 was withdrawn from service only one year earlier. In both cases, the jets were removed from active inventory for budget reasons. Some were sold to US private owners, others to arms dealers worldwide. Although not in active inventory, one jet is still used for mechanics training as an instrumental airframe at the technical college Henri Coandă Academia Forțelor Aeriene in the city of Brașov, and another is exhibited in the aviation museum in Bucharest.

Russian Federation

Russian Federation inherited an incredible 1,120 L-39Cs in the single variant C.1, with one demonstrator of the slightly improved model C.5. After the separation of the newly independent CIS countries, many of the training regiments newly belonged to other air forces, and some 60% of the L-39 fleet was retained on Russian territory. The jets were assigned to the following aviation training regiments – 44th Regiment at Panfilov-Barnaul airbase, 59th Regiment at Slavgorod airbase, 106th Regiment at Zernograd airbase, 121st Regiment at Morozovskaya airbase, 127th Regiment at Ryazhsk airbase, 627th Regiment at Salyany airbase, 704th Regiment at Kotelnikovo airbase, 706th Regiment at Volgograd airbase, 761st Regiment at



Left: Romanian L-39ZA.1 after withdrawal from service. The photo was taken in the US, and the aircraft carries no cannon, only the fairing.

Right: Russian Air Force L-39C.1 in worn camouflage, captured during a training sortie. Russian Albatrosses were all stored outdoors.

Below right: Later paint scheme of the Russian Air Force L-39 fleet. The crew is using modern ZSh-7 pilot helmets designed for MiG-29s and Su-27s.

Adzhikabul, 762nd Regiment at Kholodnogorsk, 801st Regiment at Bataysk, 959th Regiment at Yeysk, and finally 960th Regiment at Primorsko-Akhtarsk. The number of units significantly exceeded the training needs of the Russian air force, and the structure was reduced. The number of jets was slowly reduced as well due to the lack of support from Aero. However, the jets were stored and components were swapped between usable airframes. In 2000, Russia still declared ownership of 865 L-39s, although only half were operational. The jets were used primarily for domestic pilot training, as foreign courses were almost halted after 1991, with only a few courses running for countries like Rwanda, which bought Russian fighters and needed a full training course.

In the mid-1990s, a large air force reorganisation took place, with concentration of training under fewer aviation colleges, each focused on a different service of the air force and each using the L-39 as an exclusive jet platform. Tambov-based Aviation College, preparing pilots for bombers, concentrated all the L-39s with the 127th Training Regiment at Ryazhsk and the 644th Regiment at Michurinsk airbase. Kachinsky College in Volgograd, focused on front-line fighter training, concentrated its L-39s with the 704th Regiment at Kotelnikovo base, 706th Regiment at Volgograd airbase, and 801st Regiment at Bataysk. Balashov College, focused on transport aviation pilot training, also used the L-39s, assigned to the 666th Regiment at Rtishchevo and the 904th Regiment at Petrovsk. Attack aviation prepared its pilots at the Krasnodar-based college with the 704th Regiment at Kotelnikovo, 709th Regiment at Kushchevskaya, and the 802nd Combat Training Regiment at Krasnodar airbase. Finally, the Armavir College was preparing fighter pilots and was commanding the 713th Regiment at Armavir base and the 761st Regiment, which was relocated to Maykop. All remaining units were disbanded. However, this structure did not last long either, and in 2001 all Balashov and Armavir training units were subordinated to Krasnodar College. In 2004, another reorganisation took place, and the training jets were newly



stationed at Krasnodar, Rtishchevo, and Kushchevskaya airbases for the air force. Currently, the Russian air and space force L-39s are operated by the 627th Training Regiment at Tikhoretsk airbase, 644th Regiment at Michurinsk, 704th Regiment at Kotelnikovo, and 761st Regiment at Maykop airbase, while the navy uses the sole 859th centre at Yeysk airbase. The number of jets in active service has dropped below 200, of which roughly half are constantly operational. In total, Russia formally owns some 360 jets, but one-third of those were harvested for spare parts and cannot be restored to airworthy condition. Due to swapping of aggregates between operational and stored airframes, the service life of the jets is still not exceeding the limit. After passing the L-39

training, future fighter pilots continue on the Yak-130 model at Armavir and Borisoglebsk airbases; other branches use different schemes. Local companies have even developed several models of L-39 full mission simulators. The Russian Air and Space Force maintains complex overhaul capability with the 275th aircraft maintenance Regiment at Krasnodar, and the Navy with the 570th Regiment at Yeysk, both of which provide obligatory upgrades and obsolescence solutions. Until 2015, the Ukrainian industry supported operations with AI-25TL engine overhauls. Since 2007, all Russian military jets have been given RF-style registrations and are in parallel kept in a quasi-civilian register. Two L-39 jets were operated by the Kubinka-based display unit, the 237th Air Force Display Centre. They were used for liaison service and training for commanding officers. Two more were deployed at the Kant airbase in Kyrgyzstan and used for liaison tasks there within the Russian mixed air group protecting the local airspace based on an international agreement.

The Russian naval aviation entered 1992 with L-39s assigned to the 33rd centre of combat preparation and carrier crew training. Two years later, a 404th centre of combat preparation at the Ostrov base was formed, utilising L-39s, Su-25UTGs, and Su-33s. At that time, many Su-33 pilots flew more hours



Left: Fleet of Russian Air Force L-39C.1s at the OEM facility in 1997, repainted in Russ team colours as part of a marketing initiative.

Right: Slovak L-39ZA.1 with newly independent Slovak roundels, although the nose still bears the emblem of former Czechoslovak service.

Below right: Biele Albatrosy jet team, the most visible part of the Slovak Air Force in the 1990s', flying over the Slovak countryside with the Tatra Mountains in the background.

annually on the L-39 than on their final type. In 2011, all training was moved to Yeysk airbase, which was abandoned by the air force training units and became a training centre for naval aviation. New classrooms and simulators were built there, and the L-39s were later reassigned to the 859th centre of naval aviation with twelve L-39s.

In total, eight white-painted L-39s were used by the astronaut training centre named after Y.A. Gagarin, operating within the state Roskosmos organisation. All its jets were operated from the Chkalovsky airbase near the famous Star City. All jets were civilian registered, although maintained by a military organisation. The number of jets was reduced to five in 2017, with the rest being transferred to the air force. At least two more L-39s are operated by the Air Force Research Institute named after M.M. Gromov, located at Zhukovsky airport near Moscow. These jets are used for photo missions as well as recurrent training. One more L-39, named L-39D due to its demilitarised status, is operated by the St. Petersburg-based Radar MMS company, a technological centre for many naval applications.

Many L-39s were transferred to DOSAAF aeroclubs after the USSR collapse, but the organisation ceased to exist within a year and was replaced by the ROSTO organisation. It managed to continue operations only at the Vyazma airbase, where the later well-known Russ Jet Team was formed. It performed shows in several European countries, with its first international display at Hradec Králové in the Czech Republic in 1997. It may be noted that the ferry to Hradec Králové involved a breach of international aviation standards and a scramble by the Polish air force. The team operated five to six aircraft and remains somewhat operational to this day, although the ROSTO organisation was privatised and no longer has state ownership. The remaining two dozen DOSAAF aeroclubs were either privatised or closed.



Slovakia

Slovakia inherited from the Czechoslovak federation eight L-39C.1s, two L-39Vs, nine L-39ZAs and two L-39MS. Since 1st January 1993, all the L-39Cs were assigned to the 1st Squadron of the 5th Training Regiment at Košice airbase, where even some newly Czech pilots were allowed to finish their courses. In 1994, the unit was reorganised into the Air Force Training Centre operating the L-39C, L-39V and L-39MS ships, which also formally ran the Biele Albatrosy jet team. However, the two unique L-39MS ships were grounded soon and were both later sold to the USA. The centre was in the late 1990s reorganised into a training squadron of the Military Academy named after M.R. Štefánik,

Left: L-39ZA.5 during a training sortie with auxiliary fuel tanks and UB-16-57 unguided rocket blocks. Note the metal sheet in front of the cannon barrels.



Above: Slovak L-39ZA.1 in the later *Biele Albatrosy* paint scheme, here used for regular training with practice concrete bombs on multiple ejector racks.

Kuchyňa and the 31st fighter wing at Sliač. Later, all L-39ZAs were redirected to Sliač, where they formed the 2nd Training Squadron, later renamed to the 2nd Tactical Squadron, using in the last years L-39CMs and L-39ZAMs. Currently, only two L-39ZAMs are airworthy, with a few more stored after reaching the end of their service life.

Syria

Syria, a long-term operator of the L-29, ordered the L-39ZO in 1978. In total, 55 L-39ZO.1 and L-39ZO.2 jets were ordered together with TL-39 simulators, with the very last jet delivered in 1982. All were ferry flown to Syria with civilian registrations and temporary US-origin navigational systems on board. Originally, they were located at Rasin al Aboud airbase near Aleppo and Al Quasyr near Homs, from where the units of the Air Force Academy were operating. At least three jets were delivered in an all-black paint scheme and were used for celebratory flyovers during cadet graduations, all piloted by academy instructors. The fleet was used for training pilots for new MiGs and Sukhois, but due to certain weapon capabilities, planes were also sent to border areas for low-intensity combat operations. This is why the L-39ZA.2 armed variant was subsequently ordered, with forty-four jets delivered between 1983 and 1986. Many of them were located at Jirah airbase near the Turkish border, the rest at the Abu ad Duhur airbase.

Left: Another Slovak L-39ZA.1 with a full set of training ammunition – two UB-16-57 unguided rocket blocks, four CCP-100-70 practice concrete bombs, and an in-built cannon.



and the fleet continued its training role with the planes passing general overhaul at the domestic overhaul facility at Trenčín. During subsequent overhauls in 2002 and 2003, the L-39C jets' components were swapped into new spare airframes from Aero, and the planes were returned to service with new fuselage numbers. The planes were also upgraded into the L-39CM standard with modernised avionics, while the same standard was later applied to the L-39ZAM, although in that case new airframes were not used. The L-39Vs were used as spare ships for liaison and solo training roles and were operated in such roles with all the towing equipment removed. In 2004, all L-39Cs were concentrated at Sliač airbase under the newly forming 2nd Squadron. Due to budget cuts, the Biele Albatrosy team was disbanded in 2004, and two years later the L-39Vs were decommissioned.

The L-39ZAs were assigned to the 1st Squadron of the 1st Fighter Regiment at Sliač from 1993, where they were operated alongside MiG-21MF/UM and MiG-29/29UB types. In 1993, they were even enlisted into the anti-aircraft defence system of the country and helped with the interception of slow-flying intruders, typically represented by civilian planes after loss of navigation. A further three L-39ZAs were operated by the 3rd fighter bomber Regiment at Kuchyňa airbase, but they were within a few months redirected to the 1st attack squadron of the 2nd mixed Regiment operating from Trenčín airbase together with Su-25K/UBK. The latter unit was disbanded in late 1993 and its ships were transferred to regiments at Kuchyňa and Sliač. Later, a wing-based structure was introduced with the L-39ZAs assigned to the 33rd fighter wing at

Right: Syrian L-39ZO.2 in a special all-black paint scheme applied to a few aircraft used for displays at Aleppo Airbase.

Both airbases hosted mainly units responsible for border patrolling and policing against illegal migration and smuggling.

After 1990, Syria became politically isolated and lacked maintenance support for the fleet, so the number of operational jets dropped dramatically. Ukrainian contractors helped to maintain almost three dozen L-39s in airworthy condition and even introduced a local maintenance scheme for the fleet. In the new millennium, the jets were located under the 2nd Squadron at Jirah, the 678th squadron at Abu ad Duhur operating also MiG-21s, the 1st training school at Al Quasyr, and the 3rd training school at Rasin al Aboud. At the bases, many stored jets were visible on satellite images. After the 2011 rebellion, the air force concentrated all airworthy L-39s at Jirah, Rasin al Aboud, Kshesh and Shayrat airbases, from which they performed combat sorties over the cities of Aleppo and Homs. Jets were typically armed with free-fall bombs and 57mm calibre S-5 unguided rockets. Due to lack of armament, later some jets were upgraded to carry UPK-23-250 twin-barrel



cannon pods and B-13L pods for 80mm unguided rockets, both of which were officially never approved by the OEM. The Kshesh airbase was captured by Islamic rebels, and they gained control of at least six L-39ZO and ZA jets there. At least four jets were lost during combat operations and a few more were destroyed by mortar and missile attacks on the ground. After Russia launched

its operations in the country, the Syrian L-39s were maintained with help from Russian technical crews. Some twelve aircraft were repaired provisionally, and some even have patches over canopy transparencies hit by bullets – a solution clearly indicating no altitude flights with pressurisation are possible.

Tajikistan

Tajikistan captured on its territory many Mi-24V/P and Mi-8T/MT helicopters as well as An-12, An-24 and An-26 transport aircraft, mostly belonging to the Soviet border guard forces, as well as some L-29s and twelve L-39C.1s located at the Gissar airbase close to the capital of Dushanbe. The jets were not in very good condition, because the Gissar base was used for maintenance purposes and the planes were flown there for repairs or heavy maintenance. When Tajikistan faced border rebellion in the south western regions, it had to ask Russia and Uzbekistan for aerial support. It was not until 2004 that the air force managed to repair three L-39C.1s, all stationed at Kurganteppa airbase. Some sources say the jets were overhauled with Ukrainian support and the airworthiness restoration was funded by coalition forces in exchange for the rights to use Tajik airbases for strikes over Afghanistan. The L-39 fleet was then used not only for training purposes but also for patrolling flights in the border zone. However, all were grounded within two years, and in 2006 Russia donated to Tajikistan four L-39C.1s from its surplus, all freshly overhauled in Russia. Although they were overhauled, the paint scheme was not restored, and jets were delivered even with Russian roundels. They have since been located at Ayni airbase close to the Uzbek border and later moved to Gissar airbase. Their current status is unknown.

Thailand

Thailand launched its acquisition of a new advanced training type in 1992, as it needed a new trainer for its F-16s. Originally, the L-39 was not among the pre-selected types due to its Eastern origin, but this changed when the

Above Left: Syrian L-39ZO.2 during an attack sortie over Islamic rebel positions, firing from two UB-16-57 rocket pods.

Left: Recent image of a Syrian L-39ZA.2 restored to airworthy condition with help from the Russian Air Force. Note the patched bullet holes, even on the canopy transparency – clearly not qualified for pressurised flight.





Above: Tajikistan L-39C.1 donated from Russian surplus as part of international cooperation between Russia and Tajikistan.

Israeli company Elbit proposed a westernization of the jet. It provided brand-new avionics based on the Kfir type, with a full control scheme similar to Western jets. The weapons were expected to include only Western stores such as the AIM-9P Sidewinder, Dart towing targets, and Mk 80

series bombs. The L-39 suddenly became the favourite in the competition and eventually won in 1992, especially after a dynamic display of the first technology demonstrator - serial L-39ZA number 5240 - presented at the Singapore Airshow. To accelerate initial deliveries, a few unfinished L-39A.7

airframes originally ordered by the Czechoslovak Air Force but never completed were used. Between 1993 and 1997, forty jets were delivered in wooden crates via sea transport. Originally, the Royal Thai Air Force expected ten more, but the order was capped at forty due to budget constraints. Elbit provided its own simulator for the model, which gained the specific designation L-39ZA/ART. These L-39s were the very last produced, with the final aircraft being the last L-39 ever built (later deliveries came from planes ordered prior to the Thai order by the USSR or Nigeria, but delivered later to Algeria, Bangladesh, Lithuania, or Yemen).

In Thailand, the L-39s were used extensively - not only for advanced training and weapons delivery practice, but also for target towing and other missions against F-16s and Alpha Jets. The total flight log exceeded 60,000 flight hours, making Thailand one of the most active operators of the type. Originally, the jets were assigned to the 102nd Squadron at Korat AFB, but after a force reorganisation, they were reassigned to the 401st Squadron 'Dragon' at Takhli Airbase and the 411th Squadron 'Thunder' at Chiang Mai Airbase. Due to lack of OEM support, maintenance was contracted locally with the help of Czech, Bulgarian, Romanian, and Ukrainian arms dealers. Finally, in 2001, a deal to overhaul twenty-five jets by the OEM in Thailand was signed. In the advanced role, the jets were replaced by the T-50 model from South Korea and the AT-6 from the USA for the basic role. Therefore, in 2021, the L-39 type was fully decommissioned.

Above left: Royal Thai Air Force L-39ZA/ART during flight after production, still over Czech territory.



Left: Tchadian L-39ZO.1 aircraft with call sign AERO-200 used during general overhaul in the Czech Republic. The jet originally belonged to Libya.

Right: Tunisian L-59T during a test flight after its second overhaul in the Czech Republic. Note the white tail number used only for domestic flights.

Tunisia

Tunisia operated the Italian MB-326 type in the 1980s, but sought a new training aircraft for its fighter pilots. After a detailed evaluation, the L-59T model was selected for both advanced and basic training roles, alongside the transport L-410UVP model. Because the introduction of the L-59 into service in Egypt had failed, the Tunisian delivery was placed under close supervision by the Air Force command. In 1995, the first five L-59T aircraft - nicknamed 'Fennec' - were delivered, with the remaining six and one TL-59T simulator arriving the following year, all via ferry flight from Aero. All jets were equipped with smoke-generating systems for ceremonial low passes during pilot graduation. Initially assigned to the 16th Squadron at Sfax base, they were later used for patrolling and low-intensity combat missions from Gafsa Airbase near the Algerian border. Due to the withdrawal of the type from Czech and Slovak air forces and problems in Egypt, Tunisia soon became the sole operator of the L-59 worldwide, which created significant maintenance challenges. Between 2003 and 2007, Aero overhauled nine jets, as the remaining three had been lost in accidents. They were delivered to Aero aboard C-130 Hercules aircraft and returned via ferry flight. Since 2011, the L-59s played a significant role in border protection following unrest in Libya. Two years later, another overhaul programme was launched with Aero. However, as the DV-2 engine became unsupportable, the jets were used only as long as the engines remained operational. In January 2023, the very last L-59T flight took place, and the type was decommissioned after nearly thirty years of service.

Below: Ugandan L-39ZO.1, a former Libyan aircraft overhauled in Ukraine and later delivered to Uganda, flown by a Hungarian mercenary pilot.



Turkmenistan

Turkmenistan founded its air force in 1993 and inherited many powerful types such as Su-17s and MiG-29s, with only five L-39C.1s assigned to liaison roles. Two jets were eventually kept airworthy and used for training within the 31st Independent Mixed Aviation Squadron, alongside MiG-21 and MiG-29 fighters, all based at Turkmenabad Airport. Since 2009, the jets were grounded and training took place in Russia. After 2003, two L-39s were repaired and assigned to the 41st College of Aviation Specialists at Turkmenabad Airport. Later, the jets moved to Ashgabat Airbase, where the M-346FA aircraft eventually took over the training role.

Uganda

Uganda historically operated the L-29 type, and received its first three L-39ZO.1s from Libya in 1985. The armed jets were used for combat raids over the border with Zaire and performed well. One year later, they executed an impressive low pass over the capital, Entebbe. The jets were operated from Entebbe and Zulu airbases. In 2002, another L-39ZA.1

was purchased from a Bulgarian arms dealer, who also provided contracted maintenance for the fleet. In 2009, three jets underwent general overhaul in Ukraine. Because one jet was damaged, another L-39ZO.5 - originally delivered to East Germany - was acquired from the USA and militarized again. It was used primarily for training, and it is known that the jet was piloted by a Hungarian and maintained by Czech mechanics. It gained attention when the pilot posted photos showing bullet damage sustained during a flight. In 2014, three more ex-Bulgarian L-39ZA.1s were delivered, and the country also acquired a simulator, though it never received OEM support.

Ukraine

Ukraine became the second-largest L-39 operator after the USSR breakup, with at least 708 L-39C.1s remaining on its territory, all in varying technical condition due to the presence of multiple maintenance facilities. It soon became clear that the number of aircraft far exceeded the country's needs, and by 1995, the airworthy fleet was reduced to eighty,





Above: Ukrainian L-39C.1 in a national colours-themed paint scheme originally intended for a planned jet team.

Right: Ukrainian L-39C.1 in post-USSR paint scheme, with original Soviet insignia and fuselage code only repainted.

although Ukraine formally declared 430 jets in its inventory. In 1992, the jets were assigned to several training regiments, which during Soviet times were located across Ukraine. The majority of L-39s were with the 105th Regiment in Konotop, 228th in Bagerovo, 443rd in Velikaya Krukha, 701st in Chernigov, 702nd in Uman, 703rd in Horodnyia, 809th in Okhtyrka, and 810th in Chuguyev. A few jets were also assigned to fighter squadrons for training and liaison duties.

In 1993, the first major air force reorganisation took place, with L-39s reassigned to the 201st Training Regiment in Chernigov, 202nd in Novofedirovka, 203rd in Chuguyev, and 204th in Okhtyrka. Each unit formally operated fifty jets, though more than half were non-airworthy. Between 1996 and 1997, another reorganisation occurred, placing all training units under the Kharkov-based Military Air Force Academy. Only the Kyiv-based Air Force Institute and the 33rd Centre of Combat Training at Bagerovo operated outside this structure. A few jets were assigned to fighter and bomber squadrons for skill maintenance due to low availability of frontline jets. Even this structure was short-lived, and in 1999, all



training L-39s were consolidated under the 203rd Training Brigade in Chuguyev, formally part of the Kharkov Air Force University named after WWII ace pilot I.N. Kozhedub. The university operated several simulators and became the main training hub. Three more jets were assigned to the Kyiv-based National Defence University, successor to the former Air Force Institute.

Two to four jets served under the 40th Fighter Brigade at Vasilkov Airbase, the 299th Attack Brigade at Kulbakino, the 931st

Tactical Brigade at Mirgorod, the 7th Tactical Brigade at Starokonstantinov, the 204th Fighter Brigade at Belbek, and the naval 33rd Centre of Combat Training at Bagerovo. The last two units were effectively disbanded in 2014, as they were located on the Crimean Peninsula and their airbases were seized by Russian forces. Several jets were upgraded to the local L-39M1 standard with improved avionics, and the Ukrainian company Motor Sich promoted the AI-25TSLSh engine with increased thrust, though it was used in only a few jets. Currently, about a dozen jets remain airworthy, but training is extremely difficult during wartime. Nearly a hundred planes were originally kept in storage, but many were destroyed during Russian air raids due to their dispersal across various bases. The naval 33rd Centre operated Su-25UTGs and L-39s until the mid-1990s. Two more jets, formally belonging to the air force, were operated for a time by the Antonov Design Bureau and used as chase planes during maiden flights - for example, the An-148's maiden flight was documented from a L-39.

It is worth noting that there were historically two L-39 jet teams in Ukraine. The first was formed in 1995 in Uman and was



Left: Ukrainian L-39M after general overhaul and modernisation performed by Ukrainian facilities.

Right: Soviet Air Force L-39C.1 of the early series in the original paint scheme – an all-metal finish.

Below right: Later series were also delivered in this plain all-metal finish, with tail codes applied upon arrival in the USSR.

named Ukrainian Cossacks. Its first public display occurred two years later at Chaika Airport near Kyiv. Unfortunately, during pre-show practice, one jet hit the ground and its pilot was killed instantly. After this incident, only five more demonstrations took place before the team was disbanded, with the jets passed to regular units, despite two of the planes already wearing special demo paint schemes. In 1996, another team called Ukrainian Falcons was formed at Kirovskoye Airbase. It was formed by the pilots who flew in 1992 with MiG-29 and MiG-29UB to Canada and the USA. They were practicing on the L-39s before the team was rearmed with MiG-29s in 1997. In 2011, several jets received a fancy paint scheme in national colours with the aim to establish a national display team again and perform a flypast on the 20th anniversary of the country's independence, but the plan stalled. The jets were distributed to regular units and at least two were captured by Russian forces in Crimea.

A hangover from Soviet times, two overhaul plants were located in Ukraine at Chuguyev and Odessa, and they became significant in terms of L-39 re-export. Around seventy jets were re-exported to countries such as Armenia, Azerbaijan, Belarus, Cambodia, Equatorial Guinea, Georgia, Vietnam and Yemen. Almost 250 jets were sold to the USA in various conditions, and those overhaul plants were



even purchasing additional L-39s in Kyrgyzstan, for example, for spare parts prior to re-exporting them. The current status of both plants is unknown, as both are located in war-affected zones.

USA

The USA is home to hundreds of L-39s, but all are in private hands. However, a single jet found its way into short-term lease for the US Air Force. It was operated by the 412th Test Wing located at Edwards AFB, and the jet, originally delivered to the USSR and later serving in Ukraine, was leased from Teton Aviation LLC. It was registered as N439RS and, during the lease, carried USAF titles and fuselage codes 'ED' and '00-439.' When operating from Edwards AFB, it flew 126 flight hours, with its first landing at the USAF base on 21st August 2003. The aircraft was evaluated as a potential replacement for the T-39 Sabreliner training fleet, with expected capability to perform around 80% of its missions. Early in 2004, it was returned, and although further leasing was considered, it never happened. It became the sole Czechoslovak-made jet enlisted in the USAF fleet. In the USA, the L-39 is extremely popular, and the 'hobby jet' was or is owned and operated by personalities such as Elon Musk and Jared Isaacman.

Above left: Soviet Air Force L-39C.1 taxiing prior to a flight to a firing range. The jet is armed with UB-16-57 unguided rocket pods.

Left: Two Soviet L-39C.1s during a flight day at a Soviet base. Some units operated hundreds of L-39s, all but one delivered in the same variant.

USSR

The USSR became the first export customer of the L-39 type, with an incredible 2,081 aircraft delivered between 1973 and 1990, alongside TL-39 and other simulators, including a single TL-39M upgraded simulator for testing. It is noteworthy that all the jets were of a single L-39C.1 variant, except for one prototype of the L-39C.5 slightly improved model provided in 1990 for testing. Nicknamed 'Elka,' they became the major training asset of all aviation branches of the Soviet defence structure. The very first unit of the Soviet Air Force to be rearmed with L-39s was the 105th Training Regiment at Konotop Airbase in the Ukrainian republic. The instructors passed training in Czechoslovakia at Košice and directly at Aero, with the first thirteen jets formally delivered in 1973, but in reality flown to Konotop in 1974 after physical handover at Ivano-Frankivsk Airbase. At the base, the first jets landed on 29th April 1974 and were initially used for instructor training for Konotop and other bases, as well as for preparation of training syllabuses. The first cadets sat in the cockpits in 1975, and in the same year, further training regiments at Barnaul, Chernigov and Horodnyia received their first L-39s. The number of jets in service grew dramatically. While in the late 1970s some fifty to one hundred jets were delivered to the USSR annually, in 1989 exactly 248 jets were finished for the Soviet Air Force - meaning one every working day! The last airframes were delivered in 1990, although the company had several dozen planes at various stages of assembly ready to be delivered in 1991 and 1992. The reason for the delivery interruption was not politics, but rather a sudden loss of payment from the USSR. The massive delivery of two thousand jets involved thousands of pilots for ferry flights. The Czechoslovak side was responsible for flights to Ivano-Frankivsk, typically provided by air force instructors from Košice and Hradec Králové units, while Soviet pilots flew the jets to their final units.

In Soviet times, the L-39s were assigned to six armies (districts) and the independent command of the Moscow Military District. The 17th Army, with units located in the Kyiv district, became the major operator, with aviation colleges at Chernigov, Kharkiv and Lugansk airbases, where pilots for the tactical air force were prepared. Chernigov College ran the 105th Training Regiment at Konotop Airbase, the 701st Training Regiment at Chernigov Airbase, the 702nd Training Regiment at Uman Airbase and the 703rd Training Regiment at Horodnyia Airbase, each with 101 L-39Cs. Kharkiv College operated the 443rd Training Regiment at Velikaya Khruka with 101 L-39s and the 809th Training Regiment at Okhtyrka Airbase with 102 L-39s. Lugansk College commanded the 228th Training Regiment with 101 L-39s at Bagerovo Airbase.

The 76th Army in the Leningrad district operated Volgograd College with the 121st Training Regiment at Morozovskaya Airbase with eighty-eight L-39s, the 704th Training Regiment at Kotelnikovo with fifty-four L-39s and the 706th Training Regiment at Volgograd with eighty-nine L-39s. Volgograd College also prepared tactical air force pilots.

List of military L-39, L-59 and L-159 deliveries since 1972 including aircraft captured or defecting

Country	Delivery year	Variant	Qty	Origin
Abkhazia	1992	L-39C.1	4	Donated from Chechnya
	1999	L-39C.1	2	Re-export from Russia
Afghanistan	1977	L-39C.4	12	Newly produced
	1982	L-39C.4	6	Newly produced
	1984	L-39C.1	8	Newly produced
Algeria	1987	L-39ZA.1	10	Newly produced
	1988	L-39ZA.1	10	Newly produced
	1990	L-39ZA.1	12	Newly produced
	1990	L-39C.1	1	Newly produced (originally built for the USSR)
	1991	L-39C.1	6	Newly produced (originally built for the USSR)
	2002	L-39ZA.4	5	Newly produced (originally built for Nigeria)
	2003	L-39ZA.4	8	Newly produced (originally built for Nigeria)
Angola	2004	L-39ZA.4	4	Newly produced (originally built for Nigeria)
	1997	L-39C.1	2	Re-export from Belorussia
	1998	L-39ZO.1	1	Re-export from Libya
Armenia	2006	L-39C.1	2	Re-export from Slovakia
	1995	L-39C.1	2	Re-export from Russia
	2003	L-39C.1	2	Re-export from Ukraine
Azerbaijan	2011	L-39C.1	6	Re-export from Ukraine
	1992	L-39C.1	15	Seized after USSR collapse
Bangladesh	1998	L-39C.1	12	Re-export from Ukraine
	1995	L-39ZA.9	8	Newly produced (originally built for Nigeria)
Belarus	2003	L-39ZA.1	3	Re-export from Romania
	1991	L-39C.1	6	Seized after USSR collapse
	2005	L-39C.1	4	Re-export from Ukraine
Bulgaria	2006	L-39C.1	6	Re-export from Ukraine
	1986	L-39ZA.1	12	Newly produced
	1987	L-39ZA.1	6	Newly produced
Cambodia	1990	L-39ZA.1	18	Newly produced
	1995	L-39C.1	4	Re-export from Israel (origin from Ukraine)
	1997	L-39C.1	2	Re-export from Israel (origin from Ukraine)
Central African Republic	2022	L-39C.1	2	Re-export from Russia
	2023	L-39C.1	1	Re-export from Russia
Chechnya	1991	L-39C.1	62	Seized after USSR collapse
Cuba	1982	L-39C.1	30	Newly produced
Czechoslovakia	1972	L-39C	5	Newly produced
	1974	L-39C.1	15	Newly produced
	1975	L-39C.1	10	Newly produced
	1976	L-39V	8	Newly produced
	1980	L-39ZA.1	5	Newly produced
	1982	L-39ZA.1	12	Newly produced
	1986	L-39ZA.5	3	Newly produced
	1989	L-39ZA.3	6	Newly produced
	1989	L-39C.1	6	Newly produced
	1990	L-39ZA.7	4	Newly produced
	1992	L-39MS	6	Newly produced
Czech Republic	1993	L-39C.1	14	Taken over after Czechoslovak federation split
	1993	L-39V	4	Taken over after Czechoslovak federation split
	1993	L-39ZA.1	12	Taken over after Czechoslovak federation split
	1993	L-39ZA.5	1	Taken over after Czechoslovak federation split
	1993	L-39ZA.7	4	Taken over after Czechoslovak federation split
	1993	L-39MS	4	Taken over after Czechoslovak federation split
	2000	L-159A	2	Newly produced
	2001	L-159A	34	Newly produced
	2002	L-159A	22	Newly produced
	2003	L-159A	14	Newly produced
	2007	L-159T1	4	Newly produced (with use of stored L-159A)
	2010	L-159T1	2	Newly produced (with use of stored L-159A)
	2013	L-159T1	2	Returned from Spain (from CASA company)
	2018/19	L-159T2	5	Converted from operational L-159T1

Continued on page 67

Right: Soviet L-39C.1 landing with flaps deployed. This paint scheme was the final one used for deliveries to the USSR.

The 34th Army in the Caucasus district managed colleges at Armavir, Krasnodar, Stavropol and Yeysk. Armavir College, a traditional facility for anti-aircraft defence pilot preparation, ran the 627th Training Regiment with 120 L-39s located at Primorsko-Akhtarsk Airbase and the 761st Training Regiment at Hajiqabul Airbase with eighty-four L-39s. Krasnodar College, focusing on fighter pilot training and also managing foreign nationals trained in the USSR, operated the 960th Training Regiment at Primorsko-Akhtarsk Airbase with 120 L-39s, making the total number of L-39s operated at a single base 240! It is now known that Afghan, Cambodian, Egyptian, Ethiopian, Nigerian, Libyan, Syrian and Vietnamese pilots were trained there. Stavropol College commanded the 382nd Training Regiment with eighty-nine L-39s at Khankala Airbase, the 762nd Training Regiment with seventy-two L-39s at Kholodnogorsk and the 786th Training Regiment at Borisoglebsk Airbase with sixty L-39s. Yeysk College was responsible for training bomber and transport pilots and ran the 106th Training Regiment at Yeysk with ninety L-39s, the 801st Training Regiment at Bataysk Airbase with ninety L-39s and the



959th Training Regiment with 103 L-39s at Yeysk.

The 1st Army of the Siberian district, with its college at Barnaul airbase, commanded Barnaul College, responsible for tactical bomber pilot training. It consisted of the 44th Training Regiment at Panfilov-Barnaul airbase with sixty-four L-39s and the 59th Training Regiment at Slavgorod with forty-two L-39s. The 73rd Army of the Central Asian district had within its structure the 5th Pilot Training Centre, with over 100 aircraft at Frunze 1, Kant and Tomkak airbases. It was responsible for training cadets from the Central Asian republics. Finally, 112 L-39s

were subordinated to the Moscow Military District and its 127th Training Regiment at Ryazhsk airbase, where long-range bomber pilots were trained. During the engagement in Afghanistan, a detachment of the Soviet Air Force was located at Kabul and later Kandahar airbase, where local air force pilots were trained. Further L-39s were delegated to various fighter and command units for liaison service.

With in excess of one hundred jets within the majority of training regiments, it is clearly visible that the L-39 became the backbone of the Soviet Air Force training system. Some jets flew over 200 hours per year, and the flight tempo was typically organised six days a week. Cadets initially flew Yak-18s, followed by L-29s, and finally progressed to L-39s. The introduction of the L-39 into service showed that the average pilot could make their first solo flight after around forty sorties, whereas with the L-29 the number was at least double. As a result, syllabuses were modified to include approximately eighty hours on the L-29, followed by 100 to 120 hours on the L-39, where combat manoeuvres, air-to-air missions and weapons

Left: Uzbekistan operated L-39C.1s inherited from the Soviet era. During coalition operations in Afghanistan, the jets carried 'UZ AIR FORCE' titles.

Below: Current paint scheme of Uzbekistan Air Force L-39C.1s after overhaul and upgrade by the OEM in the Czech Republic.



engagement were practised. The weapon array of the L-39 allowed training with R-3U infrared-seeking missile locks, FAB-50 and FAB-100 free-fall bomb drops, and S-5 unguided rocket firings. The very first weapon training took place in 1975, initially with instructors at the controls. Later, in the 1980s, experimental courses were run where cadets underwent minimal screening on the Yak-18 and continued directly on the L-39, with some even skipping the piston stage entirely. These courses showed that after around 250 hours, pilot skill levels were comparable with the traditional scheme, and cadets were passed directly to MiG-29UB models within the experiment. Some of these pilots later participated in various MiG-29 and Su-27 development tests. The L-39 was also heavily used for Su-25 pilot training until the dedicated Su-25UB model became available. This is why L-39s were assigned to Su-25 units for a period of time.

More than two hundred L-39s were assigned to DOSAAF aeroclubs, the most famous being the Vyazma-based unit, where the Russ jet team was formed in 1987. DOSAAF units typically received jets from training units at two-thirds of their overhaul life, while training units received brand-new aircraft instead. Twenty L-39s were operated by the 33rd Centre of Combat Preparation and Carrier Crew Training, subordinated to Nikolayev College, with aircraft operated from Kulbakino, Ochakov and Novofedirovka (also known as Saki or NITKA - a Crimean airbase with an 'unsinkable carrier,' a ground replica of an aircraft carrier deck). The jets were used for recurrency training and liaison service there. Six more L-39s were used by the Astronaut Training Centre named after Y.A. Gagarin, from Tchkalovskiy airbase near the famous Star City. Further L-39s were operated by the Air Force Research Institute, Moscow Aviation Institute and other scientific organisations. The L-39 also became a very popular chase aircraft and documented the maiden flights of the An-124, Il-76 and An-225 aircraft. It was even used for research projects, such as one L-39 equipped with winglets imitating the wing ends of Il-96 and Tu-204 aircraft. Alongside the aircraft, the USSR also obtained extensive maintenance capabilities, with four maintenance plants dedicated to L-39 general overhauls. Two were located in the Ukrainian republic, in the cities of Chuguyev and Odessa; one more was located in Russia, in Krasnodar; and the final one was in Ajni, Tajikistan.

Uzbekistan

Uzbekistan founded its air force in 1992 and was able to capture eight L-39C.1s located on its territory. During the first years of independence, the air force supported border clashes with rebels entering the country from Tajikistan, and the L-39s played mostly surveillance and patrolling roles. In 1992, the air force fleet was expanded by one jet which defected from Afghanistan and was enlisted into the Uzbek Air Force. In 1993, a plan to release all Russian nationals was implemented, and the air force then suffered from a serious lack of personnel. After a series of reorganisations, all L-39s were assigned to the Mixed Aviation Brigade

List of military L-39, L-59 and L-159 deliveries *continued*

Country	Delivery year	Variant	Qty	Origin
Czech Republic <i>continued</i>	2018	L-159T2	1	Newly produced
	2019	L-159T2	2	Newly produced
	2024/25	L-39NG	4	Newly produced (ongoing)
Djibouti	1991	L-39C.1	1	Defection from Ethiopia, never operated
East Germany	1977	L-39ZO.5	21	Newly produced
	1978	L-39ZO.4	27	Newly produced
	1982	L-39ZO.1	4	Newly produced
	1980	L-39V	2	Delivered from Czechoslovak air force active inventory
Egypt	1993	L-59E	26	Newly produced
	1993	L-39ZO.1	10	Re-exported from Libya
	1994	L-59E	23	Newly produced
Equatorial Guinea	2007	L-39C.1	2	Re-exported from Ukraine
Eritrea	2014	L-39C.1	1	Defection from Ethiopia, never operated
Estonia	2005	L-39C.1	5	Commercially owned aircraft, leased only
Ethiopia	1983	L-39C.1	10	Newly produced
	1988	L-39C.1	10	Newly produced
	1997	L-39C.1	2	Newly produced (originally built for the USSR)
	1998	L-39C.1	4	Newly produced (originally built for the USSR)
	2004	L-39ZA.1	5	Re-exported from Bulgaria
Ghana	1993	L-39ZO.1	3	Re-exported from Libya
Georgia	2007	L-39C.1	8	Re-exported from Ukraine
	2008	L-39C.1	4	Re-exported from Ukraine
Germany	1990	L-39ZO.5	20	Taken over after Germany reunification
	1990	L-39ZO.4	26	Taken over after Germany reunification
	1990	L-39ZO.1	4	Taken over after Germany reunification
	1990	L-39V	2	Taken over after Germany reunification
Hungary	1993	L-39ZO.4	20	Re-exported from Germany
	1994	L-39ZO.5	4	Re-exported from Germany
	2025	L-39NG	2	Newly produced (ongoing)
	2026	L-39NG	10	Newly produced (ongoing)
Iran	1991	L-39ZO.7	2	Defection from Iraq, never operated
Iraq	1975	L-39C.2	22	Newly produced
	1976	L-39ZO.6	27	Newly produced
	1977	L-39ZO.6	1	Newly produced
	1981	L-39ZO.7	10	Newly produced
	1984	L-39ZO.7	10	Newly produced
	1985	L-39ZO.7	10	Newly produced
	2015	L-159A	3	Re-exported from Czech air force active inventory
	2015	L-159T1	1	Re-exported from Czech air force active inventory
Islamic state	2016	L-159A	7	Re-exported from Czech air force storage inventory
	2017	L-159T1	1	Newly produced (with use of stored L-159A)
	2013	L-39ZO.2	2	Seized in Syria
Kazakhstan	2013	L-39ZA.2	4	Seized in Syria
	1991	L-39C.1	16	Seized after USSR collapse
Kyrgyzstan	1998	L-39C.1	9	Re-exported from Russia
	1999	L-39C.1	4	Re-exported from Russia
Libya	1991	L-39C.1	72	Seized after USSR collapse
Libya	1978	L-39ZO.1	35	Newly produced
	1979	L-39ZO.1	37	Newly produced
	1981	L-39ZO.1	22	Newly produced
	1982	L-39ZO.1	44	Newly produced
	1983	L-39ZO.1	43	Newly produced
Lithuania	1994	L-39C.1	4	Re-exported from Kyrgyzstan
	1998	L-39ZA.4	2	Newly produced (originally built for Nigeria)
Luhansk people's republic	2014	L-39C.1	1	Seized on Ukrainian territory
Mali	2021	L-39C.1	4	Re-exported from Russia
	2023	L-39C.1	9	Re-exported from Russia
Mozambique	2013	L-39ZO.4	1	Re-exported from Romania (originally Hungarian a/c)
	2013	L-39ZO.4	1	Re-exported from Romania (originally Hungarian a/c)
	2014	L-39ZA.1	1	Re-exported from Romania
	1986	L-39ZA.4	12	Newly produced
Nigeria	1987	L-39ZA.4	12	Newly produced
	1986	L-39ZO.1	2	Re-exported from Libya, never operated
Romania	1981	L-39ZA.1	8	Newly produced
	1982	L-39ZA.1	4	Newly produced
	1983	L-39ZA.1	8	Newly produced

Continued on page 69

Right: Vietnamese L-39C.11 from original deliveries in the 1980s. An OEM flight crew is preparing it for a test flight after assembly, as suggested by the absence of fuselage codes.

Below right: In recent decades, Vietnamese L-39C.1s were overhauled locally with this paint scheme. This aircraft was delivered from Ukrainian surplus.

at Jizzax airbase, where Su-25s, Mi-24V/Ps and Mi-8T/MT/MTVs were also operated. An air force academy is located there as well, although the country has historically relied on Ukraine and other nations for training. In 2015, five L-39s were reported as operational, all supported by the maintenance regiment located at Chirchiq airbase. In 2001, the air force leased the Karshi-Khanabad airbase to US and NATO forces for operations over Afghanistan, and the Uzbek jets were all marked with clearly visible 'UZ AIR FORCE' titles for easy recognition. The lease allowed funds to be used for the overhaul of five L-39s in Ukraine in 2004. In 2014, another tender for the overhaul of four L-39Cs was released, and later in 2018, they were sent to Aero for complex overhaul and a simple upgrade. All returned in 2019 aboard Il-76 cargo aircraft.



Vietnam

Vietnam ordered its first L-39s in 1979, although its pilots had already been familiar with the type for several years, having trained in the USSR. In 1980, the first twelve L-39C.11 models were delivered, followed by another twelve one year later, along with TL-39 simulators. They were delivered via combined sea and rail transport due to the distance from Aero. It is worth noting that Aero mechanics, during previous L-29 maintenance and L-39 post-delivery assembly, were tasked with a special mission - they were testing available F-5E Freedom Fighter jets. Vietnam donated one US-origin fighter to Czechoslovakia, and Aero mechanics were asked to perform engine and function tests and select the F-5 in the best condition. Eventually, they found one aircraft still equipped with AIM-9 Sidewinder

Above left: Yemeni L-39C.1 in fresh paint. Originally produced for the Soviet Air Force but never delivered due to early 1990s turmoil.

Left: Some Yemeni L-39C.1s operate in harsh conditions. Shelters do not always provide full protection.

Below: One of the L-39C.1s delivered from Ukrainian surplus. These jets received a different desert-themed paint scheme.

missiles and cannon rounds. The Sidewinders were removed, but the rest of the jet, along with ground support equipment and documentation, was sent back to Czechoslovakia in the wooden crates previously used for L-39 delivery.

The L-39s were assigned to the 910th Training Regiment at Nha Trang, which until 1993 was named after Czechoslovak communist hero Julius Fučík. The tropical environment required many modifications, including different surface treatments, so the jets gained the specific designation L-39C.11. In 1990, only eighteen jets were declared operational, and the air force began building its own maintenance capability, eventually managing to finalise the transfer of Al-25TL engine overhaul, although very few engines were repaired locally. Between 2002 and 2003, ten L-39C.1 models were bought from Ukraine and delivered after general overhaul, later followed by ten rather obsolete but still useful IAK-52 aircraft from Romania. Currently, roughly sixteen jets are operational, and Aero has performed multiple service life extension programmes. They are still operated under the 910th Training Regiment, but now from its new location at Dong Tac airbase. Several jets have been lost over the years. In very late 2023, a few L-39NG jets were delivered, with a total of twelve on order and potentially an additional twelve as an option.

Yemen

Yemen searched for new training jets shortly after its unification in 1991, as the unclear political orientation of the newly united state led to the departure of all Soviet advisors, leaving the country without any training capability. In 1998, a deal for twelve L-39C.1s - originally intended for the Soviet Air Force - was signed with Aero, with all aircraft delivered in 2000. They were assigned to the Training Squadron at Al-Anad airbase. In 2005 and 2006, the fleet was boosted by a further fourteen L-39C.1s from Ukrainian surplus stocks, all delivered after overhaul. However, even such a large fleet did not function effectively, as Yemen was unable to secure spare parts and support for both the L-39 and the piston-powered Zlin Z-242L.

After the civil war broke out in 2014, a few jets were transferred to the 12th Squadron at Taizz airbase for combat patrolling. Unfortunately, the majority of the fleet was grounded, and Yemen also suffered from a lack of trained pilots. The anti-government Houthi rebels adopted a tactic of assassinating jet pilots before they could enter the airbase perimeter, which significantly reduced the Yemeni Air Force's combat capabilities.

Unconfirmed Operators

Especially in the Western press, many reports mention L-39 operation in Albania, Croatia, Kenya, Morocco, Moldova, Mongolia, Venezuela and Zaire (currently the Democratic Republic of Congo). It can be considered certain that these countries never operated the type, and some confusion may stem from the operation of military-painted but civilian-registered L-39 'hobby jets'. The only truly unconfirmed operator is North Korea, which might have received some jets from Russia in the 1990s, although confirmation is extremely difficult.

List of military L-39, L-59 and L-159 deliveries *continued*

Country	Delivery year	Variant	Qty	Origin
Romania	1984	L-39ZA.1	8	Newly produced
	<i>continued</i> 1985	L-39ZA.1	4	Newly produced
Russian federation	1991	L-39C.1	1120	Seized after USSR collapse
	1991	L-39C.5	1	Seized after USSR collapse
	2014	L-39M1	4	Seized in Ukraine (Crimean Peninsula)
Slovakia	1993	L-39C.1	8	Taken over after Czechoslovak federation split
	1993	L-39V	2	Taken over after Czechoslovak federation split
	1993	L-39ZA.1	3	Taken over after Czechoslovak federation split
	1993	L-39ZA.3	5	Taken over after Czechoslovak federation split
	1993	L-39ZA.5	1	Taken over after Czechoslovak federation split
	1993	L-39MS	2	Taken over after Czechoslovak federation split
Spain	2010	L-159A	3	Re-exported from Czech air force active inventory to CASA
	2010	L-159T1	2	Re-exported from Czech air force active inventory to CASA
Syria	1980	L-39ZO.1	19	Newly produced
	1980	L-39ZO.2	22	Newly produced
	1981	L-39ZO.2	6	Newly produced
	1982	L-39ZO.2	8	Newly produced
	1983	L-39ZA.2	16	Newly produced
	1984	L-39ZA.2	20	Newly produced
	1985	L-39ZA.2	7	Newly produced
	1986	L-39ZA.2	1	Newly produced
Tajikistan	1992	L-39C.1	12	Seized after USSR collapse
	1999	L-39C.4	2	Defection from Afghanistan
	2007	L-39C.1	4	Re-exported from Russia
Tchad	1996	L-39ZO.1	10	Seized in Tchad (Libyan a/c)
Thailand	1993	L-39ZA/ART	16	Newly produced
	1994	L-39ZA/ART	20	Newly produced
	1995	L-39ZA/ART	2	Newly produced
	1997	L-39ZA/ART	2	Newly produced
Tunisia	1995	L-59T	6	Newly produced
	1996	L-59T	6	Newly produced
Turkmenistan	1992	L-39C.1	5	Seized after USSR collapse
Uganda	1985	L-39ZO.1	3	Re-exported from Libya
	2002	L-39ZA.1	1	Re-exported from Bulgaria
	2009	L-39ZO.5	1	Re-exported from USA (originally East German a/c)
	2014	L-39ZA.1	3	Re-exported from Bulgaria
Ukraine	1991	L-39C.1	708	Seized after USSR collapse
	1993	L-39C.1	10	Re-exported from Kyrgyzstan
	2024	L-39ZA.4	1	Donated from Lithuania
USA	2003	L-39C.1	1	Commercially owned aircraft, leased only
USSR	1973	L-39C.1	13	Newly produced
	1974	L-39C.1	59	Newly produced
	1975	L-39C.1	57	Newly produced
	1976	L-39C.1	73	Newly produced
	1977	L-39C.1	82	Newly produced
	1978	L-39C.1	57	Newly produced
	1979	L-39C.1	94	Newly produced
	1980	L-39C.1	77	Newly produced
	1981	L-39C.1	89	Newly produced
	1982	L-39C.1	52	Newly produced
	1983	L-39C.1	91	Newly produced
	1984	L-39C.1	148	Newly produced
	1985	L-39C.1	184	Newly produced
	1986	L-39C.1	193	Newly produced
	1987	L-39C.1	207	Newly produced
	1988	L-39C.1	227	Newly produced
	1989	L-39C.1	248	Newly produced
Uzbekistan	1990	L-39C.1	130	Newly produced
	1990	L-39C.5	1	Newly produced
Uzbekistan	1992	L-39C.1	8	Seized after USSR collapse
	1992	L-39C.1	1	Defected from Afghanistan
Vietnam	1980	L-39C.11	12	Newly produced
	1981	L-39C.11	12	Newly produced
	2002	L-39C.1	4	Re-exported from Ukraine
	2003	L-39C.1	6	Re-exported from Ukraine
	2023	L-39NG	2	Newly produced
	2024/25	L-39NG	10	Newly produced (ongoing)
Yemen	1999	L-39C.1	3	Newly produced (originally built for the USSR)
	2000	L-39C.1	9	Newly produced (originally built for the USSR)
	2005	L-39C.1	2	Re-exported from Ukraine
	2006	L-39C.1	12	Re-exported from Ukraine

Number of civilian L-39 registrations

Country	Variant	Quantity
Australia	L-39C	16
Brazil	L-39C	1
Estonia	L-39C, L-39ZO, L-39ZA	31
France	L-39ZO	3
Czechoslovakia (Including ferry registrations)	L-39C, L-39ZO, L-39ZA	118
	L-39MS	4
Czech Republic	L-39C, L-39ZA	20
Canada	L-39C, L-39ZA	10
Lithuania	L-39C	8
Luxembourg	L-39ZO	5
Norway	L-39C	1
New Zealand	L-39C	6
Russia (without Air Force registrations)	L-39C, L-39ZO	79
São Tomé and Príncipe	L-39C	1
San Marino	L-39C, L-39ZA	4
Slovakia	L-39C	3
South Africa	L-39C, L-39ZA	15
Ukraine	L-39C	12
United Kingdom	L-39C, L-39ZO, L-39ZA	11
	L-159E	8
USA	L-39C, L-39ZO, L-39ZA, L-39V	303
	L-39MS	5
	L-139	1
	L-159A	3
	L-159E	21
Venezuela	L-39C	2

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Dedication:

To my beloved wife Petra, charming daughter Noemi and amazing son Samuel for the great support, patience, and joy they every day bring to my life.

L-39, L-59, L-139 and L-159 Technical data

Variant	L-39	L-39C	L-39ZO	L-39ZA	L-59T	L-139	L-159A
Wingspan	9,44 m	9,44 m	9,44 m	9,44 m	9,54 m	9,46 m	9,54 m
Fuselage length	12,13 m	12,13 m	12,13 m	12,13 m	12,20 m	12,13 m	12,73 m
Fuselage height	4,70 m	4,70 m	4,70 m	4,70 m	4,78 m	4,70 m	4,70 m
Stabilator span	4,70 m	4,70 m	4,70 m	4,70 m	4,70 m	4,70 m	4,70 m
Wing area	18,8 m²	18,8 m²	18,8 m²	18,8 m²	18,8 m²	18,8 m²	18,8 m²
Wheel track	2,44 m	2,44 m	2,44 m	2,39 m	2,42 m	2,39 m	2,42 m
Wheelbase	4,39 m	4,39 m	4,39 m	4,39 m	4,37 m	4,39 m	4,57 m
Empty weight	3198 kg	3455 kg	3496 kg	3578 kg	4030 kg	4610 kg	4350 kg
Max take-off weight	4300 kg	4700 kg	5600 kg	5648 kg	7000 kg	6000 kg	8000 kg
Max speed	680 km/h	750 km/h	750 km/h	750 km/h	871 km/h	770 km/h	936 km/h
Climb rate	16 m/s	22 m/s	22 m/s	22 m/s	25 m/s	21 m/s	50 m/s
Ceiling	11000 m	11500 m	7500 m	7500 m	7800 m	12 000 m	13 200 m
Range – internal fuel	900 km	1000 km	1015 km	1015 km	1020 km	1690 km	1570 km
Range – ext. fuel tanks	900 km	1000 km	1650 km	1850 km	1980 km	2778 km	2430 km
Endurance - internal fuel	2:0 h:m	2:30 h:m	2:30 h:m	2:30 h:m	2:45 h:m	3:25 h:m	2:15 h:m
G-load	+8/-4 g	+8/-4 g	+8/-4 g	+8/-4 g	+8/-4 g	+8/-4 g	+8/-4 g
Take-off distance	600 m	480 m	970 m	940 m	590 m	500 m	342 m
Landing roll	700 m	600 m	800 m	800 m	770 m	608 m	570 m
Engine type	AI-25W	AI-25TL	AI-25TL	AI-25TL	DV-2	TFE 731-4-1T	F124-GA-100
Engine thrust	14,42 kN	16,87 kN	16,87 kN	16,87 kN	21,58 kN	18,15 kN	28 kN
Hardpoints wing/fuselage	2/0	2/0	4/0	4/0	4/0	4/0	6/1
Hardpoints capacity	500 kg	500 kg	1000 kg	1000 kg	1600 kg	1000 kg	2700 kg
Inbuilt weapon	0	0	0	GŠ-23	GŠ-23	GŠ-23	0

* Data are taken from OEM leaflets.

L-39 X-10 in an experimental camouflage scheme applied shortly before the end of its flying career. The application was labour-intensive and never became standard.



L-39 frequently displayed at various air shows. In reality, this airframe never flew; it was a ground test bench for various systems and was not even equipped with an engine.



L-39 X-07 prototype in its very early paint scheme, soon changed for test deployment in the USSR. Note the rounded nose tip, a feature unique to this aircraft.



L-39ZA test aircraft used to verify the L-39ZA.4 avionics, as indicated by the wire antenna on the tail fin.



L-39ZA.7 prototype used to test the avionics selected by the Royal Thai Air Force for its L-39ZA/ART model, featuring Western avionics and weapons. It shares the same paint scheme as the previous aircraft.



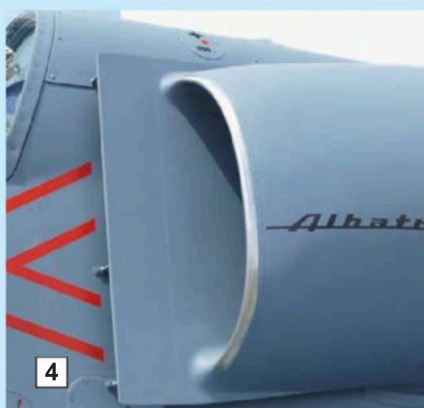
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Aero L-39, L-59, L-139 & L-159 Albatros

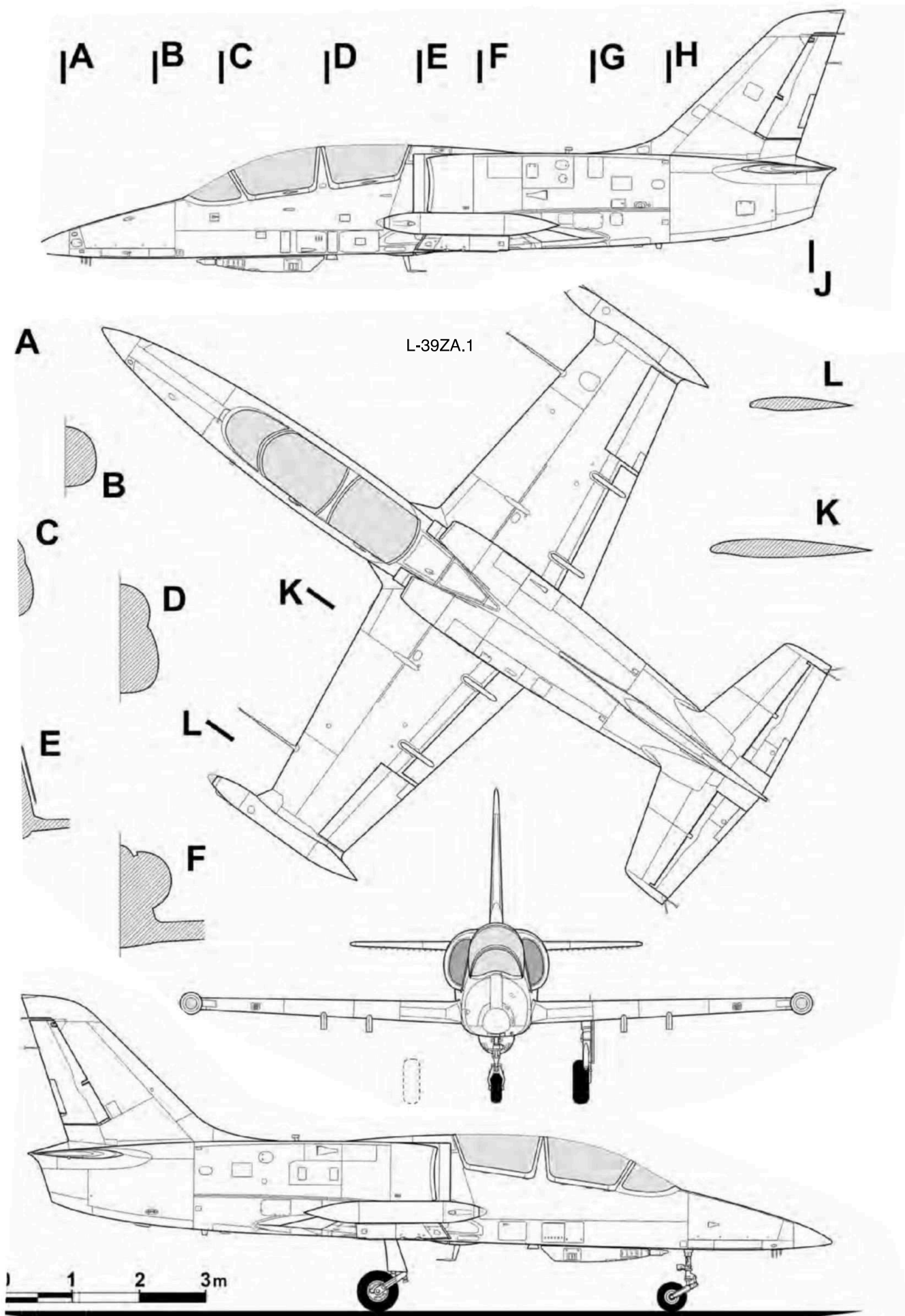
IN DETAIL



1. Nose section of the L-39ZA model, showing the cannon mounted beneath the fuselage.
2. The L-39 fuselage features numerous removable panels for easy maintenance.
3. Engine intake with large diverter plate. The metal lip is part of the engine heating system.
4. Detail of the engine intake with the fuel cap located above. Only gravity refuelling is possible.
5. L-39 cockpits are equipped with built-in steps, which can be closed by the pilot.
6. Detail of the nose landing gear. It lacks a steering system, with differential braking used instead.
7. Detail of the main undercarriage, showing the wheel and brake discs.
8. Al-25TL engine. Brown components are part of the oil system; yellow lines indicate fuel routing.
9. Wing hardpoints fitted with aerodynamic fairings to reduce drag.
10. Tail section of the L-39ZA, with vortex generators located beneath the stabiliser.
11. Wing trailing edge with ailerons and flaps in the extended position.
12. Detail of the wingtip tank, showing the position light and landing light.
13. Opposite side of the tail fin. Note the signal flare cartridge mounted at the base.
14. Detail of the tail pipe. Trimming tabs are clearly visible on the elevator.
15. Main structural components of the L-39 – fuselage, wings, tail, and tip tanks.

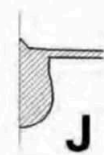
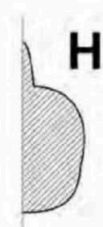
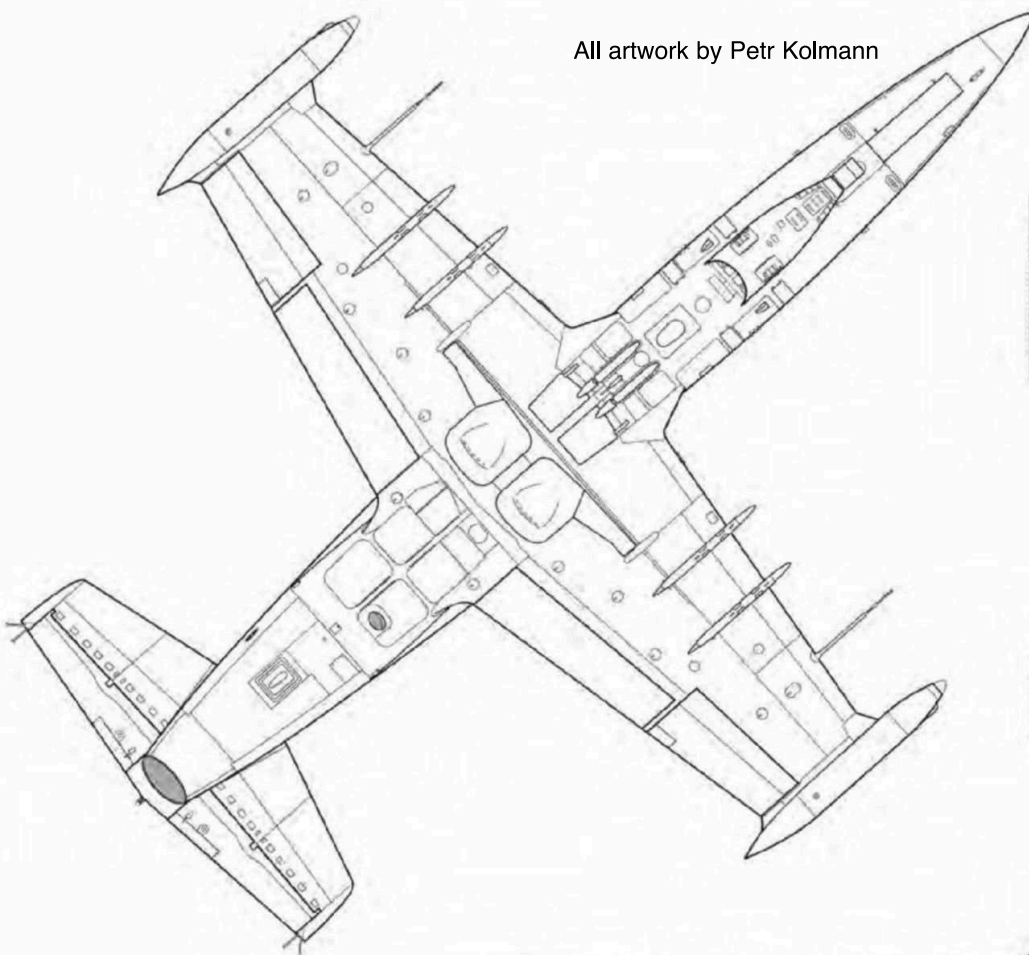




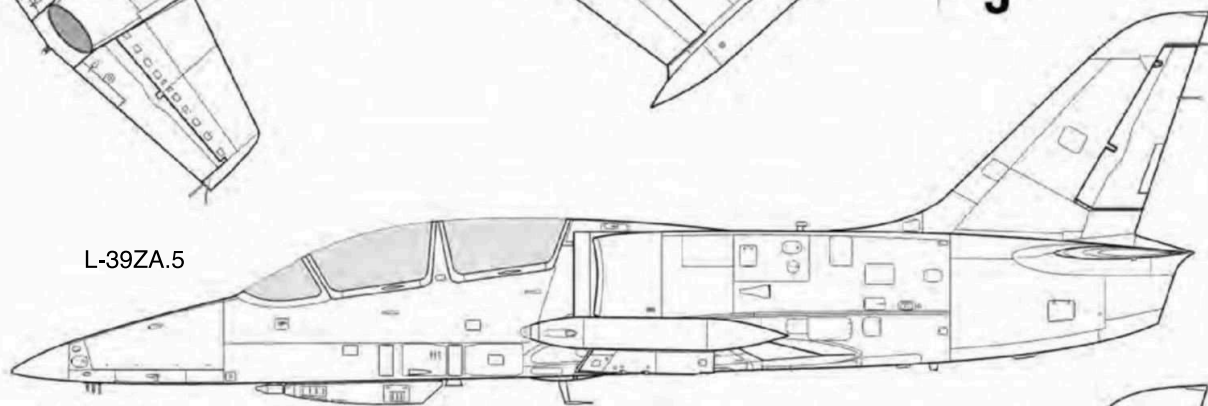


L-39ZA.1

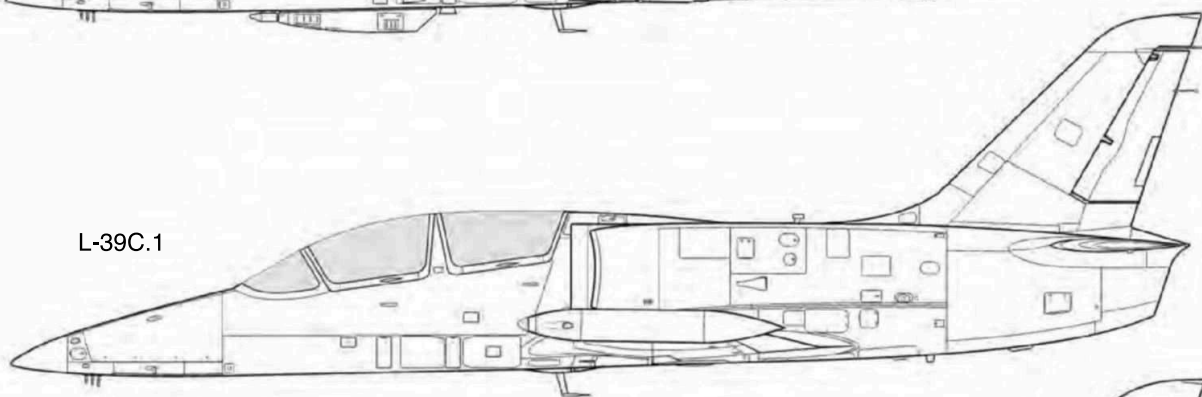
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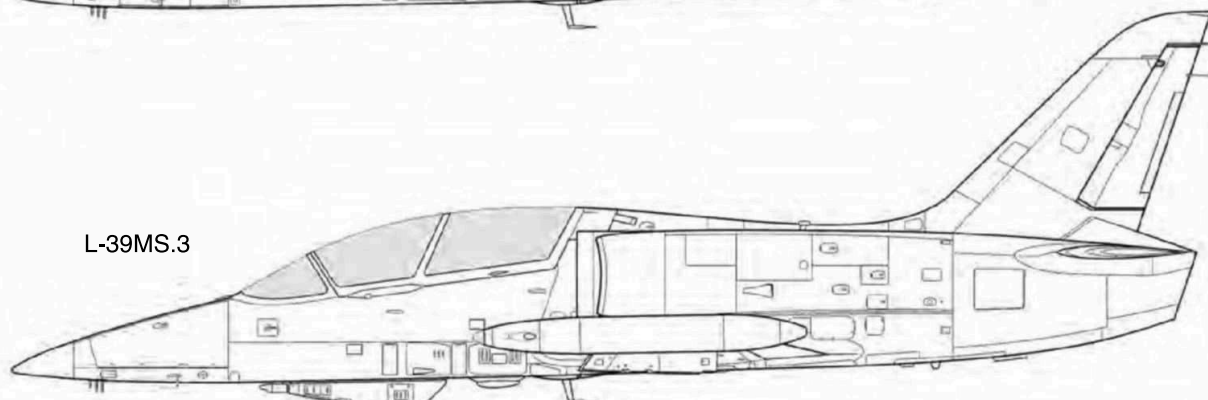
L-39ZA.5



L-39C.1



L-39MS.3



Initial series of L-39C.1s for the Czechoslovak Air Force were delivered in this metal finish, previously verified on some prototypes.



For easier surface maintenance and cleaning, the metal finish of Czechoslovak L-39C.1 training aircraft was soon replaced with this white scheme featuring grey undersides.



In the 1980s, Czechoslovak L-39Cs and ZAs adopted this tactical camouflage, which was also used by training units.



One of the Czechoslovak L-39C.1s operated by the *Biele Albatrosy* jet demonstration team, which transferred to Slovakia after the federation split and retained the paint scheme.



Czech Air Force L-39ZA.1 in the standard paint scheme with additional details applied after 1990, when uniform fleet camouflage requirements were relaxed.



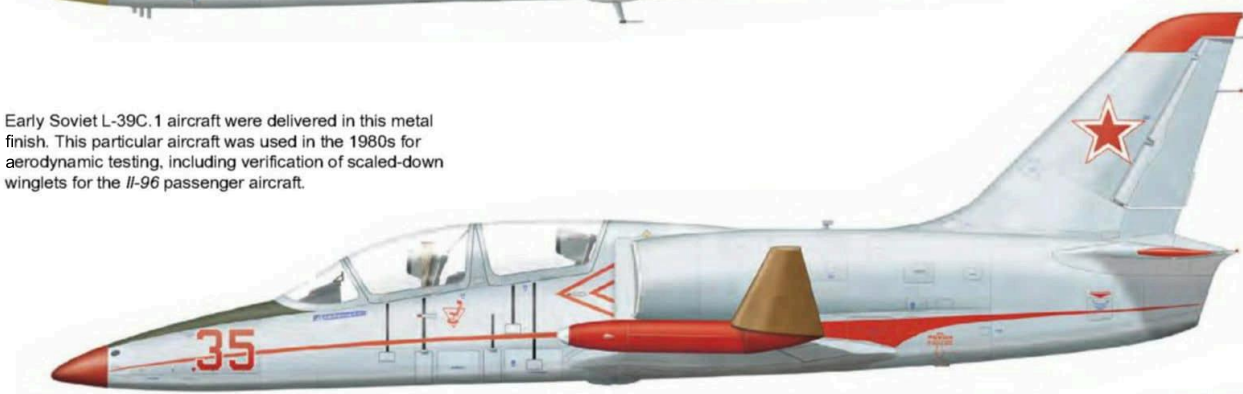
Czech Air Force L-39V from the early 1990s. Note the Budweiser brewery logo on the tail fin – the *České Budějovice* squadron was a prominent ambassador for the brand.



Final paint scheme of the L-39C.1 after transfer from the Czech Air Force to the CLV training centre operated by LOM PRAHA s.p.



Early Soviet L-39C.1 aircraft were delivered in this metal finish. This particular aircraft was used in the 1980s for aerodynamic testing, including verification of scaled-down winglets for the *Il-96* passenger aircraft.



Later standard Soviet paint scheme used on roughly a hundred aircraft. Fuselage numbers were added once aircraft were assigned to training regiments. The *Albatros* name on the intakes was in Cyrillic.



The vast majority of Soviet L-39C.1s were delivered in this camouflage scheme, with yellow elements indicating a training jet. The *Albatros* name on the intakes was in Cyrillic.



Early Iraqi training L-39C.2s resembled one of the Czechoslovak prototype camouflage schemes, with the air force academy emblem on the nose.



Iraqi L-39ZO.6 assigned to the air force academy, as indicated by the nose emblem. Jets assigned to tactical units lacked this emblem, although they shared the same paint scheme.



East German L-39ZO.4s featured the same camouflage as Soviet aircraft, but with German insignia and the *Albatros* name written in Latin script on the intakes.



Both East German target-towing L-39Vs retained the original Czechoslovak high-visibility camouflage previously used.



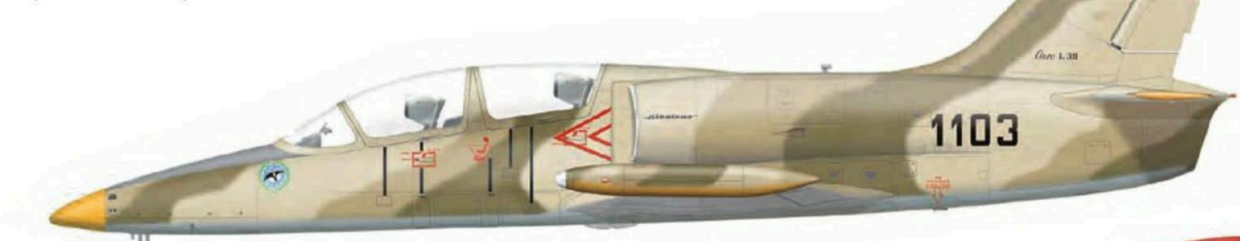
Bulgarian L-39ZA.1s were delivered in a camouflage slightly different from the Soviet standard. A few years later, the insignia were replaced with post-revolution roundels.



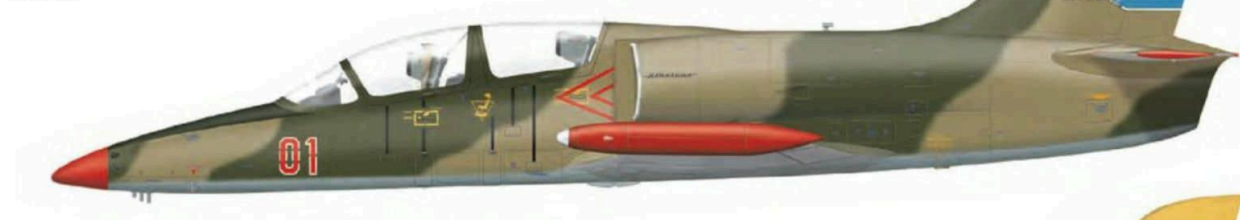
Romanian L-39ZA.1s were all delivered in this all-metal finish, which was actually a gloss silver lacquer painted over the entire airframe.



Libyan L-39ZO.1 in a typical scheme with the air force academy emblem on the nose. All jets were delivered to Libya in the same livery.



The very first Cuban L-39C.1 in its original factory finish, delivered in wooden crates by sea. In the 1990s, all surviving jets were repeatedly repainted in various schemes.



Likely only three Syrian L-39ZO.1s were delivered in 1980 in this all-black camouflage. These jets were used for aerobatic displays, despite the black paint being unsuitable for extremely hot environments.



Syrian L-39ZO.2 from the early 1980s. These aircraft were ferry-flown with Czechoslovak civilian registrations on the tail.



Vietnamese L-39C.11 in the paint scheme worn after delivery. Fuselage numbers were added after a few months of operation.



Afghan L-39C.4 with a later style of roundel used under Soviet influence from 1982 onwards. Only a few jets from the initial batch were finished in this scheme; the majority were delivered with camouflage.



Late style of Kabul-based Afghan L-39C.4 from the period of re-establishing the Afghan air wing during Operation Enduring Freedom.



One of the Nigerian L-39ZA.4s from the initial delivery. Later, these aircraft often flew with the cannon removed to improve weight and performance.



One of the early-delivered Algerian L-39ZA.1s in its original paint scheme, later replaced with sand colours. The numbering sequence was random.



L-39 X-02 prototype in a paint scheme used in the later stages of flight testing. It had an all-metal finish. The VZLÚ institute logo is visible on the air intake.



L-39 X-03 prototype in a paint scheme with calibration marks used for canopy and ejection seat tests. Note the original small air intake with bypass doors.



L-39 X-05 prototype was the only aircraft featuring this camouflage. The nose bears the title *Sokol* (Falcon), although the type's name at the time was *Albatros*.



L-39 X-06 prototype with an experimental paint scheme intended for jets destined for Libya. Due to modified avionics, it features a nose boom with additional test sensors.



L-39 X-07 prototype in the camouflage scheme it wore while operated by the Soviet Air Force during type trials in the USSR. Stencils were in Cyrillic.





Above: Similar in paint scheme, the L-39ZA/ART testbed flying alongside a series production L-39ZA/ART in Royal Thai Air Force colours.

Below: A Czech L-39 L-39ZA.7 in the early 1990s. Note the tip tank colour differs from the rest of the jet – a result of a ground collision.



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